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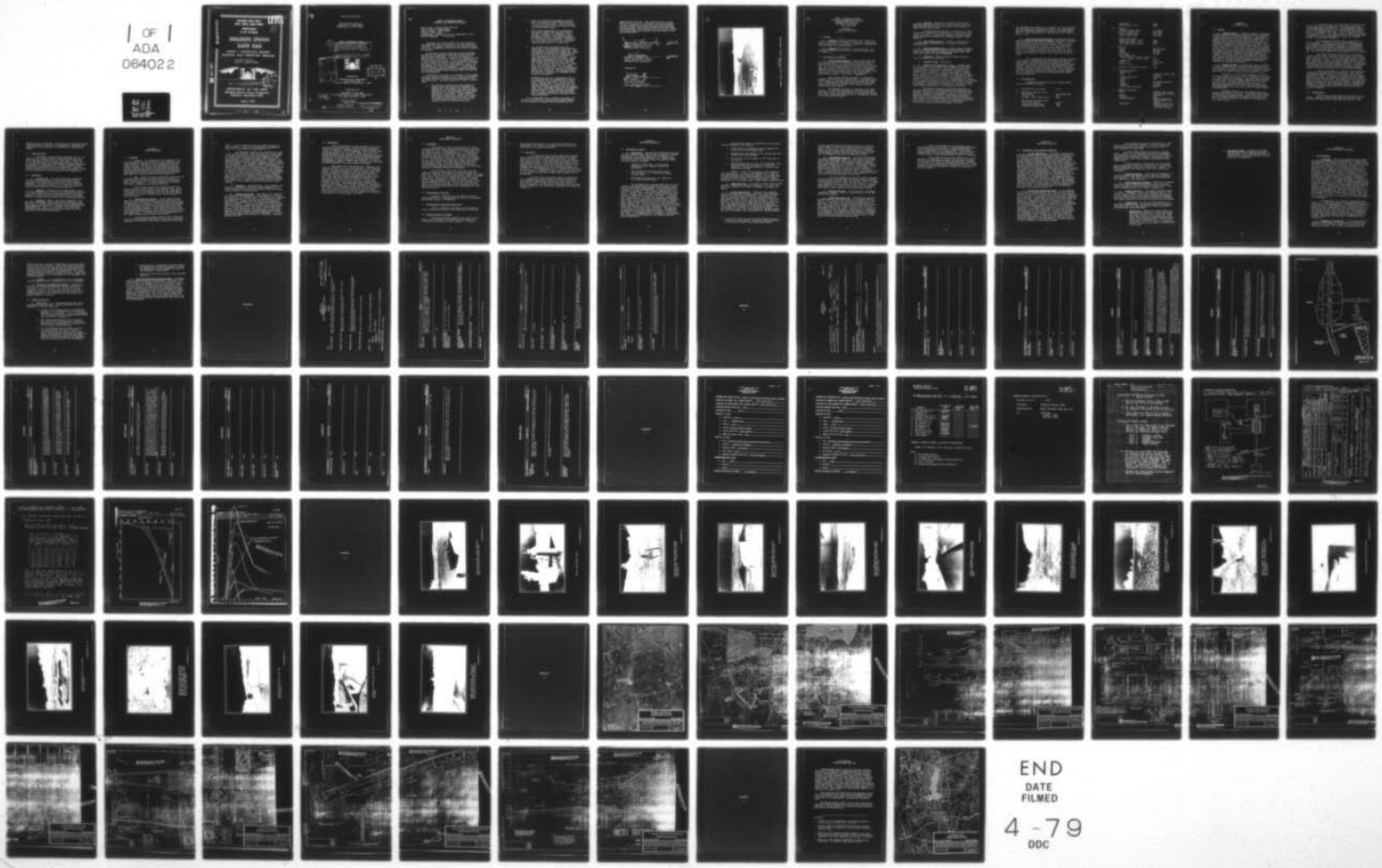

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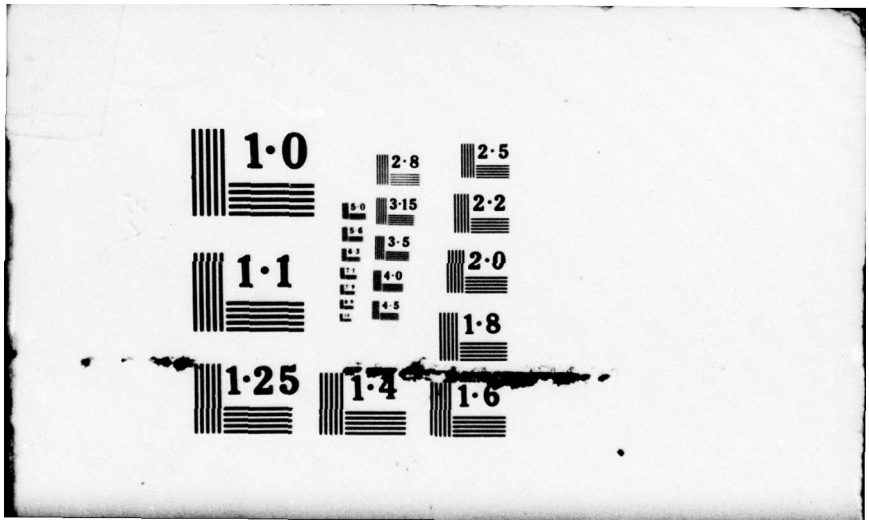
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LEVEL II

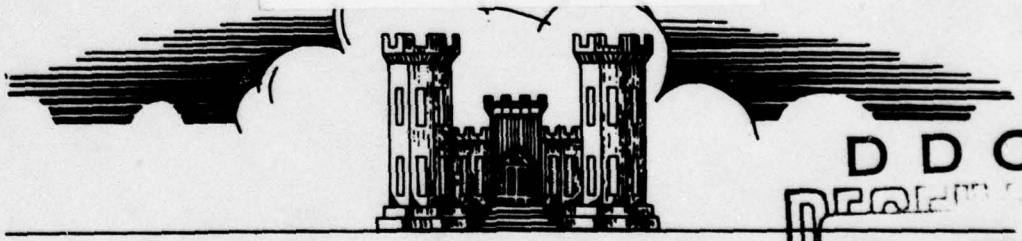
B.S.

DELAWARE RIVER BASIN
ARIEL CREEK, WAYNE COUNTY

PENNSYLVANIA
ID NO. PA.00166

ROAMING WOODS LAKE DAM

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

JULY 1978

DELAWARE RIVER BASIN

ROAMING WOODS LAKE DAM
WAYNE COUNTY, PENNSYLVANIA
NATIONAL I.D. NO. PA 00166

(6) PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM.
Roaming Woods Lake Dam (ID PA-00166),
Delaware River Basin, Ariel Creek, Wayne
County, Pennsylvania. Phase I Inspection
Report.

(15) DACW31-78-C-0048

Prepared by:

WOODWARD-CLYDE CONSULTANTS
5120 Butler Pike
Plymouth Meeting, Pennsylvania 19462

Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Roaming Woods Lake Dam
County Located: Wayne County
State Located: Pennsylvania
Stream: Ariel Creek
Coordinates: Latitude 41° 25.3' Longitude 75° 20.7'
Date of Inspection: 29 June 1978

Examination of Roaming Woods Lake Dam resulted in the assessment that the facility is in good operating condition. No suspect conditions were noted that would give rise to immediate concern for the overall integrity of this dam.

Calculations indicate that the existing spillway systems are not adequately designed to pass the Probable Maximum Flood (PMF). The spillway capacity is judged to be "Inadequate" in that it was designed to pass only 50 percent of the PMF. The dam is classified as a "High" hazard dam because of the residential dwellings located around Lake Genero, approximately 3/4 of a mile downstream, and other structures along the channel to the headwaters of Lake Wallenpaupack. In the event of failure, extreme property damage is expected including five highway bridges between Roaming Woods Lake Dam and Lake Wallenpaupack.

Although the structure is considered to be in good condition, several deficiencies and items of maintenance are described below together with recommendations for correcting them. They are presented in order of preference.

1. The emergency spillway approach channel is asphalt paved and serves as a parking lot and marina. The parking area contains automobiles, boats, trailers and other associated facilities. It is surrounded by large boulders and floating docks. These obstacles could have a significant effect on the spillway capacity and provisions should be made to remove these obstacles when flow is expected through the emergency spillway.

2. There is no operating procedure to assure that the required minimum downstream flow (1.44 cfs) is maintained. This is currently being satisfied solely by excessive leakage of the sluice gates.

3. Some riprap displacement was noted along the water's edge on the upstream slope of the dam. Although the condition is not considered critical, the condition should be rectified before it becomes hazardous to the integrity of the structure. Performing this maintenance work now, would minimize rehabilitation costs at a later date.

4. In conjunction with the evaluation of conditions within the watershed, major retention structures in the basin were inspected. This investigation revealed that seepage was occurring beneath the spillway of Brooks Lake and that the toe area along the embankment of this impoundment was wet and marshy. It was noted that discharge from Lake Ariel passes immediately downstream of Brooks Lake and may account for the marshy areas along the toe. Since Brooks Lake is at least 6 inches below the spillway crest while all other lakes are at normal pool, it is reasonable to expect that significant seepage is occurring beneath the structure. This seepage should be assessed to determine if hazardous conditions are developing.

   Wildwood Lake was also investigated and it was observed that the embankment is covered with hardwood trees several inches in diameter. Should these trees die and the root systems decompose, it is expected that the stability of this embankment would be jeopardized. This embankment should be evaluated to determine what, if any, measures are necessary to insure stability of this structure and to minimize potentially hazardous conditions downstream.

It is recommended that a program of periodic inspection be performed to detect any possible changes in the integrity of Roaming Woods Lake Dam and its

appurtenant facilities. This should include a checklist to insure that all pertinent items are inspected. A formal procedure for observation and warning during periods of high precipitation should also be developed and implemented. This procedure should include a method of warning downstream residents that high flows are expected downstream.

John H. Frederick, Jr., P.E.
Maryland Registration 3701
Woodward-Clyde Consultants

16 Aug 78
Date

William S. Gardner, P.E.
Penna. Registration 004302E
Woodward-Clyde Consultants

16 Aug 78
Date

APPROVED BY:

JOHN H. KENWORTHY
LTC, Corps of Engineers
Acting District Engineer
DATE: 25 August 1978

OVERVIEW
ROAMING WOODS LAKE DAM, WAYNE COUNTY, PENNSYLVANIA

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
ROAMING WOODS LAKE DAM
NATIONAL ID #PA 00166
DER ID #64-196

SECTION 1
PROJECT INFORMATION

ABSTRACT

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

ABSTRACT

1.2 Description of Project.

a. Dam and Appurtenances. Roaming Woods Lake Dam is a zoned rolled earth embankment with riprap facing on the upstream slope. The dam is approximately 400 feet long and 32 feet high as measured from the original streambed. The dam was designed with an upstream core section composed of silty clay and clayey silt and a downstream section consisting of glacial till and glacial sands. The dam contains a downstream blanket drain connected to a downstream toe drain. (See Plate 3, Appendix E).

The principal intake consists of a reinforced concrete riser with a weir on each side. Contained in the intake riser is a 36-inch sluice gate to drain the reservoir. Approximately 8.0± feet from the top of the riser is an 8-inch gate valve which can be used to maintain minimum flow requirements.

The emergency spillway is located on the right abutment. A road curb functions as the controlling weir. This concrete weir is approximately 15 inches high and 292 feet long. The present parking lot is the approach channel for the emergency spillway.

b. Location. The dam is located on Ariel Creek, approximately three-quarters of a mile north of Route 590 and three-quarters of a mile upstream of Lake Genero in Wayne County, Pennsylvania.

The dam site and reservoir are shown on the USGS "Lakeville, Pennsylvania" Quadrangle, at coordinates N 41° 25.3'; W 75° 20.7'. A Regional Location Plan for Roaming Woods Lake Dam and Reservoir is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as "Intermediate", consistent with a reservoir storage of 2249 acre-feet.

d. Hazard Classification. A "High" hazard classification is assigned because of downstream residential dwellings around Lake Genero and homes along Ariel Creek, between Lake Genero and Lake Wallenpaupack.

e. Ownership. Hideout Property Owner's Association, Lake Ariel, Pennsylvania.

f. Purpose of Dam. Recreation.

g. Design and Construction History. Roaming Woods Dam was designed by E. D'Appolonia, Consulting Engineers of Pittsburgh, Pennsylvania. The application report for construction was submitted on September 2, 1969 to the Delaware River Commission. Construction began in August, 1970. During the initial stripping and excavation of the cutoff trench at the right abutment, the material was found to be more granular than that which was indicated by the borings and test pits in this area. Subsequently, E. D'Appolinia, Consulting Engineers, Inc., excavated additional trenches to investigate foundation conditions. As a result of their supplemental investigation, modifications were made to the basic design presented in the construction drawings.

Construction changes included the expansion of the drainage blanket, and enlargement of the upstream clay blanket. Additional clay material were also placed at the approach channel of the emergency spillway to provide an impervious blanket for seepage. Additional precautions were taken in the emergency spillway by adding filter materials to prevent fines from washing out from beneath the riprap channel. All of these changes are documented in a letter by E.D'Appolonia dated September, 28, 1970.

The embankment was topped out in January 1971, and the spillway was completed in the Spring of 1971. The final Department of Enviormental Resources inspection was performed on March 25, 1971, and approval to impound water was issued on April 2, 1971.

h. Normal Operating Procedures. Discussions with the Community Engineer for Hideout Property Associates indicated that operating procedures are extremely limited. It was understood that during the winter months, the reservoir is drawn down approximately three to five feet below normal pool for the purpose of minimizing the effects of ice forces on the docks and other facilities along the water's edge. As a secondary benefit, the lower reservoir level allows the reservoir to receive clean water during Spring thaws.

It is understood that the eight inch drain located in the intake riser was installed to supply minimum flow requirements in accordance with the application permit. There are no records of this valve ever being used for this purpose nor are there records that minimum flows are maintained. Normally, water flows over the intake riser and maintains the water level at normal pool. It is understood that the emergency spillway has never functioned. There are no records available describing operating procedures for this reservoir.

1.3 Pertinent Data.

A summary of pertinent data for Roaming Woods Dam is presented as follows:

a.	Drainage Area (Sq. miles)	9.63
b.	Discharge @ Dam Site (cfs)	
	Max. Known	No records kept
	At Elev. 1327	530
	At Elev. 1331.5 (Top of Dam)	8312
c.	Elevations (Feet above MSL)	
	Top of Dam (Crest)	1331.5
	Primary Spillway Weir	1324
	Emergency Spillway Weir	1327

	Pond Drain	1307
	8-inch Pipe Orifice	1318±
d.	Reservoir	
	Length at Normal Pool	1.3 miles
	Fetch at Normal Pool	0.9 miles
	Area at Normal Pool	205 acres
	Area at Top of Dam	254 acres
e.	Storage (Acre-Feet)	
	Normal Pool (Elev. 1324)	2249
	Flood Pool (Elev. 1327)	2894
	Top of Dam (Elev. 1331.5)	3965
f.	Dam Data	
	Type	Rolled Earth
	Length	400 feet
	Height	32 feet
	Top Width	24 feet
	Side Slopes (H:V)	
	Upstream-Crest to Elev. 1315.0	2:1
	Elev. 1315.0 to Toe	3.5:1
	Downstream	2.5:1
	Cutoff	Core trench
	Grout Curtain	None
g.	Diversion & Regulating Tunnel	None
h.	Principal Spillway	
	Intake Riser	
	Type	2 parallel weirs, drop inlet
	Length (each weir)	16.5 feet
	Elevation	1324
	Tunnel	
	Type	Reinforced Concrete
	Diameter	5.5 feet
	Length	116 feet
	Exit Invert Elevation	1301.1
i.	Emergency Spillway	
	Type	Concrete weir across asphalt paved surface
	Length	292± feet
	Elevation	1327
	Upstream Channel	Asphalt paved area used as parking for marina
	Downstream	Asphalt highway discharging into a rip-rap lined channel

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. A detailed summary of engineering data available on Roaming Woods Lake Dam is presented in the checklist, attached as Appendix A. Engineering design data available for this dam and reservoir was contained primarily in the design drawings, dated 1969. A complete set of hydrologic/hydraulic design calculations for Roaming Woods Lake was presented in a document prepared by E. D'Appolonia Consulting Engineers, Inc., Pittsburgh, Pennsylvania, dated August 1969. Based on letters in the files, it is reported that structural calculations including stability studies and structural calculations for the intake riser were presented to the Department of Environmental Resources. However, these data could not be located in the DER files. Details concerning construction history and modifications to the dam as a result of the findings revealed during foundation preparation were included in a series of letters prepared by DER and E. D'Appolonia, Consulting Engineers.

b. Design Features. The principal design features of Roaming Woods Lake Dam and appurtenant structures are illustrated on the plans, profiles, and cross-sections that are enclosed in Appendix E, as Plates 2 through 8. These plates are reproduced from microfilm supplied by DER.

The dam is a zoned earth embankment, 440 feet long with a crest width of 24 feet. The height of the dam is 32 feet above the streambed. The normal pool elevation is 1324.0 feet and the designed highway elevation (crest) is 1332± feet. The lake impounds 205 acres in area at normal pool and contains 2249 acre-feet of water. At the crest elevation of 1331.5 feet, the lake area would be approximately 250 acres with a volume of approximately 4,000 acre-feet.

Discharge capacity of both the principal and emergency spillway is 8,312 cfs. The maximum flood inflow is estimated to be approximately 10,350 cfs. which conservatively assumes failure of the upstream Wildwood Lake Dam. The total watershed area used for this design was 9.63 square miles.

A cutoff trench, five feet deep and ten feet wide at the base, with side slopes of 1.5H:1V was constructed 16 feet upstream of the dam axis. The embankment consists of selected compacted earth fill obtained from the reservoir floor. The upstream slope has a 3.5H:1V inclination from the toe to elevation 1315, then a 2.0H:1V slope to the crest, at elevation 1331.5. The upper portion of the upstream slope is faced with a three-foot depth of riprap on a one-foot blanket of stone filter material.

The downstream slope has been constructed on a 2.5H:1V slope. A three-foot thick gravel blanket was constructed beneath the downstream portion of the embankment. This blanket is hydraulically connected to a gravel-filled french drain with an eight-inch diameter perforated pipe. The drain pipe discharges seepage into the creek below the dam. The dam crest supports a paved highway along its length.

The primary spillway consists of a reinforced concrete intake tower, 16.5 feet by 13.5 feet in plan dimensions. The top of the tower is at elevation 1327.8. Normal pool elevation is 1324.0. The intake tower contains a trash rack, pond drain, sluice gate and an eight-inch gate valve. The intake riser discharges through a 66-inch I.D. reinforced concrete pipe which is buried beneath the dam. A downstream stilling basin and channel transition zone dissipate the energy and channels the water into the existing streambed.

Along the western end of the dam (right abutment) an emergency spillway has been constructed. The crest of the emergency spillway weir is at elevation 1327 and has a length of 292 feet. The approach to the spillway is asphalt covered and is currently used as a parking lot and storage area for boats and trailers. Surrounding this area are large decorative rocks, up to six feet in diameter. The approach channel contains two marina buildings, vending machines and sanitary facilities. The downstream slope is riprapped for a distance of approximately 100 feet and drains into the natural streambed.

2.2 Construction.

Construction records were not available for this review: however, contacts were made with the consulting engineers who designed and supervised the project. They

assured us that no abnormal conditions were encountered beyond those described in Section 1.2, paragraph g. Otherwise all construction was completed in accordance with the original design.

2.3 Operation Data.

The Permit indicates that a minimum flow of 1.44 cubic feet per second would be maintained below the dam. During periods when the inflow is less than 1.44 cfs, however, flow exiting need only equal the inflow. There are no records that these flow requirements are being maintained. No upstream or downstream weirs, needed to measure these flows could be located during this inspection. Since the Community Engineer did not know of these requirements, copies of this documentation were forwarded for his information.

2.4 Evaluation.

a. Availability. All engineering data reproduced in this report and studied for this investigation were provided by the Pennsylvania Department of Environmental Resources. The Owner's engineer was available to provide information about the structure and to show the inspection team pertinent features of the dam and reservoir.

b. Adequacy. Because of the limited amount of detailed engineering data available, the assessments resulting from this investigation were based primarily on the visual inspection, verbal reports of the Owner and the hydrologic/hydraulic calculations performed by the inspection personnel.

c. Validity. Based on the visual inspection, construction photographs, design drawings, and letters in the DER files, it has been judged that the dam and appurtenances were probably constructed in accordance with the designer's recommendations. There is no evidence to indicate that construction procedures deviated significantly from those proposed by the consulting engineer.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The observations and comments of the field inspection team are outlined in the checklist, enclosed herein as Appendix B and are summarized and evaluated as follows. In general, the appearance of the facility indicated that the dam and its appurtenances were properly constructed and are reasonably well maintained. The upstream and downstream flow measuring stations which were specified to aid in regulating minimum flow requirements were not located during the field inspection.

b. Dam. During the visual inspection, there were no indications or evidence of distortions in alignment or grade that would be indicative of movement of the embankment or the foundation. A careful inspection of the dam disclosed no seepage on the downstream slope.

Minor riprap erosion and distortions were observed along the water's edge of the upstream face. These distortions can be attributed to wave action. Although it is believed that this distortion will not adversely effect performance of the dam, rehabilitation may be necessary in the near future.

c. Appurtenant Structures. At the time of the inspection, water was just below the primary discharge weir. The spillway structure was inspected and there were no signs of deterioration or movement. The sluice gate, at the base of the structure, and the eight-inch gate valve were exercised and operated properly. Both valves were found to be in good operating condition. There were no signs of significant deterioration, spalling or collection of debris around the intake riser. The tunnel could not be inspected along its length because of flow through the system.

The principal spillway retaining walls and stilling basin were inspected and found to be in good condition. There was no spalling or deterioration observed in the wing

walls. One minor tension crack was observed along the left wing wall. This crack is described in Appendix B, Sheet 6 of 11 and shown on Photograph No. 10.

The emergency spillway was inspected and found to be in good condition. There was only very minor spalling of the weir section which can probably be attributed to highway traffic hitting this dual purpose weir and curb structure. The approach channel was observed to be asphalt paved and used as a parking area. Details of the approach channel are described in Appendix B and in Section 2.1, paragraph b. The discharge channel downstream was inspected and the riprap appears to be in good condition. A concrete retaining wall is located along the left abutment of the spillway which is conjugal with the right abutment of this dam. This concrete retaining wall was constructed to prevent erosion of the dam in the event of the passing of a storm over the emergency spillway. Some standing water was observed at the base of the emergency spillway, between the toe of the spillway and the discharge channel. This appears to be a natural topographic low and not associated with under seepage through the spillway or under the dam.

d. Reservoir. Reconnaissance of the reservoir disclosed no evidence of siltation, slope instability, or other features which would significantly affect the flood storage capacity of the reservoir.

e. Downstream Channel. The channel was inspected and appeared to be stable with trees growing in the flood plain down to the streambed edge. The channel was inspected for approximately 3-1/2 miles to the head waters of Lake Wallenpaupack. Between the dam and Lake Wallenpaupack there are approximately 10 to 12 homes around Lake Genero (shown on Plate 1). Several other homes are located along the stream channel between Lake Genero and Lake Wallenpaupack. In case of failure, the homes on Lake Genero and several of the homes along the stream would be inundated together with five highway bridges between Roaming Woods Lake and the head waters of Lake Wallenpaupack. It is estimated that damage would begin at a discharge of approximately 3,500 cfs.

3.2 Evaluation.

With the exception of minor movement of the riprap along the upstream slope, the survey of the dam disclosed no evidence of apparent past or present movement to indicate instability of the embankment. The wet area noted on the downstream side of the dam immediately below the emergency spillway was assessed to be a topographic low that stores rainfall runoff and not associated with underseepage of the dam. The downstream toe of the embankment was inspected and no signs of seepage were observed. In general, the embankment appears to be in good condition and the drainage system appears to be functioning as designed.

The intake riser and valves were inspected, exercised and observed to be in good condition. The emergency spillway was also inspected and observed to be in good condition. The approach channel, which is asphalt paved and currently used as a parking and storage area for boats of the Main Marina, contains obstructions to flow in the event that flood waters Pass through this emergency spillway. The decorative rocks surrounding the marina are, in general, below the crest of the weir. It has been assessed that these rocks would only have minimal affect on flood discharge. The downstream riprap channel was inspected and is judged to be in good condition. Immediately downstream of the discharge channel the flood plain widens out significantly and water would pass into the woods. Some minor erosion would be expected during the passing of flood waters but this erosion is not expected to jeopordize the stability of the spillway or the dam.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures.

The reservoir level is regulated by an intake structure which contains two parallel weirs 16.5 feet long at elevation 1324. A photograph of the intake riser and the weirs are shown on Photograph No. 1. Incorporated in the intake riser is a 36-inch gate used as a pond drain located at the base of the riser. The valve is located on the upstream side of the riser, as shown on Photograph No. 2. In addition, an eight inch valve is also located on the riser at elevation 1318± with a gate adjacent to the pond drain gate. All water that enters the riser is discharged through a 66-inch diameter concrete reinforced concrete pipe which discharges into a stilling basin. The pipe is embedded beneath the embankment.

Data located in DER files indicates that the eight inch pipe was designated for use to maintain minimum flow. However, this valve was closed. During the inspection, water was found to be flowing through leaks in the pond drain valve. This flow was estimated to meet or exceed minimum flow requirements. During the winter, the reservoir is lowered three to five feet so that the water level is below the dock facilities. Since this structure was built, the emergency spillway has never experienced flow. There are no other known operational requirements for this dam and reservoir.

4.2 Maintenance of the Dam.

The dam is maintained by the Hideout Property Owners Association. They periodically check the structures and perform repairs, as necessary.

4.3 Maintenance of Operating Facilities.

Valves, located in the riser, are exercised at least once per year (winter) and lubricated at that time.

4.4 Warning Systems in Effect.

The design engineer reported that there are no formal warning systems or procedures established to be followed during periods of heavy rainfall. If hazar-

dous conditions develop, or if high flow conditions are anticipated, the local Civil Defense Authority would be notified by the Community Engineer.

4.5 Evaluation.

It is believed that current operating procedures are a realistic means of operating the relatively simple control facilities of Roaming Woods Lake Dam. Although the eight-inch valve is not being used to maintain minimum flow, normal leakage of the pond drain gate appears to be satisfying this flow. During the lifetime of this facility sediment may eventually block the pond drain system. If minimum flow requirements are to be continued through the pond drain, it is recommended that 1) the gate be exercised at least yearly to maintain an open channel to the drain and 2) the valve be calibrated to assure that minimum flow is maintained.

A formal warning procedure should be formulated to be implemented during periods of extreme rainfall so that residents downstream, especially in the vicinity of Lake Genero, could be amply warned when high volumes of flow are expected. The operation procedures should be formalized, together with a maintenance procedure and inspection checklist.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Data.

a. Design Data. The original design data reviewed for this structure was complete and consisted of "Design Calculations for Roaming Woods Lake", prepared by E. D'Appolonia, Consulting Engineers, Inc. (August 1969). The calculations for Roaming Woods Lake Dam were based on the following references:

1. "Design of Small Dams", United States Department of the Interior, Bureau of Reclamation.

2. Soil Conservation Service (SCS), Engineering Memo No. 27, criteria for design of earth dams.

3. SCS Technical Release No. 29, Hydraulics of Two-Way Covered Risers.

The watershed above Roaming Woods Lake is hydrologically and hydraulically complicated because of many natural and man-made impoundments in the upstream areas. A schematic of the watershed area, as used in design, is enclosed in Appendix C. The largest impoundment is Lake Ariel, a natural lake whose water surface has been elevated by a concrete weir. A gate is furnished in the weir section to lower the reservoir by two feet. A man-made lake, Wildwood Lake, is 1,000 feet upstream from Roaming Woods Lake, and is approximately 18 feet deep. Deerfield Lake, with a surface area of 26 acres, and Brooks Lake, with a surface area of eight acres, are also upstream from Roaming Woods Lake. The total drainage area is 9.63 square miles with elevations ranging from above 1,600 feet to 1,324 feet, at the normal pool elevation. The watershed is more than 50 percent wooded and marshy. Residential development covers approximately 30 percent of the drainage area. It is expected that 50 percent of the watershed will ultimately be developed by the "Hideout Property Owners Association".

The following items of information were extracted from the designer's calculations:

1. Flood routing included the storage capabilities of Lake Ariel and Wildwood Lake.

2. Wildwood Lake was assumed to fail during the freeboard storm flood routings.

3. An SCS run-off curve number of 70[1] was used in the design.

4. Roaming Woods Lake, as well as all upstream lakes, were considered as SCS Class "B" structures. Therefore, the dam was designed to pass at least one-half of the PMF.

Items 1, 2 and 3 are considered to be reasonable and conservative. In view of the possibility of loss of life and expected severe property damage, it is judged that the spillway should have been designed as an SCS Class "C" structure to pass the PMF. This is equivalent to Federal Guidelines for a structure with a "High" hazard classification.

b. Experience Data. No rainfall or pool level records are kept. The normal operating procedure is to lower the reservoir surface 3 to 5 feet, in October, to prevent ice damage.

c. Visual Observations. Detailed visual observations concerning the reservoir, spillways, and downstream channel are contained in Appendix B. It should be noted that the approach channel to the emergency spillway is paved and is being used as a marina, parking lot and storage area for canoes, boats, and boat trailers. Also located in this area are two sheds used by the marina personnel. The lakeward sides of the marina are lined with large decorative boulders with tops that are approximately at or below the elevation of the emergency spillway. It is considered likely that flow through the emergency spillway will be slightly, but insignificantly, reduced because

(1) *SCS Curve 70 provides input data for runoff computations based on a description of the watershed. Normal curve numbers range from 60 to 100 with the higher values yielding higher runoff.*

of the increased losses resulting from the flow through the boulders. Flow could be further reduced (unless all boats, trailers, etc., are removed prior to an extreme event) by the lighter boats and canoes being floated over the emergency spillway and possibly being caught on the weir or dropped on the road or downstream channel.

d. Overtopping Potential. The inflow hydrographs for Roaming Woods Lake consist of the routed outflow from Lake Ariel and Wildwood Lake, plus the uncontrolled portion of the watershed. The designer routed a freeboard storm which equals one-half the PMF. The maximum reservoir elevation is computed to be 1330.6 for this storm. Consideration was also given to failure of Lake Wildwood, in which case the reservoir elevation rises to elevation 1331.2. The design top of dam is 1331.5. The computed overflow, combined from both spillways, was computed to be at the top of the dam and equal to 8,312 cfs.

Since no allowance was made for storage afforded by the numerous upstream ponds and marshy areas, including Deerfield Lake and Brook Lake, the over-all design is judged to be conservative for a Class "B" structure, i.e., a structure designed to pass one-half the PMF. However, Roaming Woods Lake Dam is a "High" hazard structure in accordance with Federal (OCE) Guidelines and should pass the PMF.

e. Spillway Adequacy. The spillway is considered "Inadequate" because it can only pass one-half of the PMF without overtopping.

f. Downstream Conditions. Roaming Woods Lake Dam is approximately 1,500 feet above Lake Genero, which appears to be a shallow lake formed by the damming of a marshy area. Lake Genero has ten vacation homes along its shores and the lake is crossed by Pennsylvania State Route 590. The bridge opening beneath State Route 590 is approximately 40 feet by 7 feet. Because of the location of the bridge over an impoundment (Lake Genero), no estimate of the maximum flow through the bridge without overtopping was performed. The homes around Lake Genero and the few other homes downstream along Ariel Creek justify a "High" hazard rating for Roaming Woods Lake Dam.

Ariel Creek enters Lake Wallenpaupack about 2.5 miles downstream of Lake Genero. Lake Wallenpaupack is a 5,700 acre man-made lake with a maximum 60-foot depth and a drainage area of 228 square miles. Failure of both Roaming Woods Lake Dam and Wildwood Lake Dam would have minimal effect on Lake Wallenpaupack's reservoir elevation.

Ariel Creek Valley, located between the two reservoirs, is predominantly wooded, quite narrow in places and contains less than two dozen homes subject to damage in the event of a failure of Roaming Woods Lake Dam. Since the area is being developed for residential use, it is considered likely that the number of homes will increase in the near future.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. The visual inspection of Roaming Woods Lake Dam and its appurtenant facilities did not indicate any existing embankment stability problems or structural problems associated with the intake riser or the emergency spillway. Some riprap distortions were observed along the upstream slope at the water's edge. It has been assessed that these distortions are associated with the wave action produced by boats or the wind. Although these distortions are not considered to be detrimental to the stability of the structure, the riprap should be repaired to prevent further deterioration. There was no exterior evidence noted on the embankment or surrounding area to indicate that the drainage systems, constructed within the embankment, were malfunctioning. The intake riser was observed to be in good condition. The emergency spillway was inspected and the approach channel weir and discharge channel are judged to be in good condition. The approach channel is currently being used as a Marina which could affect the ability of this system to pass the probable maximum flood (PMF). Further discussions of the emergency spillway are located in Section 5.

b. Design and Construction Data. It was reported by the Owner's representative that the borrow sources designated by the design engineer were used for the construction of the dam. During foundation construction, conditions were observed to be somewhat different than those disclosed by the borings. These conditions were evaluated by the engineer, E. D'Appolonia Consulting Engineers, Inc., and appropriate measures were taken to prepare the foundation for dam construction. These conditions were well described in a letter dated September 28, 1970, by Mr. Richard E. Ellison to Mr. Joseph Ellam, Department of Environmental Resources. This letter described the conditions and the modifications that were performed to adjust the geotechnical conditions in the foundation. Foundation materials were somewhat coarser and more pervious than estimated from the boring logs. Accordingly, the Contractor overexcavated these materials and replaced them with more impervious materials. The embankment was extended upstream to form a blanket over the west abutment.

The emergency spillway was covered with a layer of silty clay to minimize seepage. A filter blanket was constructed beneath the riprap to prevent the loss of fines through the riprap zone.

No other modifications were found in the DER files. Letters of correspondence together with memoranda. and inspection reports indicated that the dam was built in accordance with the design criteria. Construction photographs located in DER files document some phases of the construction.

Structural design calculations for the embankment, boring logs, stability evaluations, soil tests and seepage computations were not in DER files. However, the dam configuration and materials used in the design are reasonable.

c. Operating Records. There was no information reviewed that gave any indication that stability problems have occurred or that there is any hazard associated with the operation of this structure.

d. Post-Construction Changes. There were no reports nor is there any evidence that modifications or alterations were made to this dam other that those noted in the report prepared during the foundation preparation.

e. Seismic Stability. This dam is located in Seismic Zone I. Normally, it can be considered that if a dam in this zone is stable under static loading conditons, it can be assumed safe for any expected earthquake condition. Since the static stability analyses could not be reviewed, the seismic stability of the dam could also not be evaluated.

f. Upstream Dam. As part of the inspection, all significant lakes within the drainage basin were inspected. Two lakes which have been assessed to require further investigation are described below.

1. Brooks Lake. Seepage was noted beneath the spillway discharge slab. Marshy areas were also noted along the toe of the dam. These zones may or may not be seeping since Lake Ariel Creek discharge flows immediately downstream of the embankment toe. It is noted that Brooks Lake is at least six inches below normal pool while other dams in the basin are at full pool

2. Wildwood Lake Dam. Extensive tree growth was noted on both the upstream and downstream slopes. This conditon should be investigated in view of its effect on the stability of the embankment.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Assessment. The visual inspection and review of the design and construction documentation indicates that the embankment and appurtenant structures of Roaming Woods Lake are in generally good condition. There were no signs of significant seepage on the downstream slope. There were no cracks or signs of significant deterioration or spalling in the intake riser to indicate structural instability. The discharge conduit, although it could not be inspected for the full length, was observed at the upstream end and there were no signs of distortions or misalignment to indicate potentially unstable conditions. The emergency spillway was also inspected and assessed to be in good condition. The approach channel is cluttered with boat trailers, cars, boats, and other attendant structures associated with the Marina. Floating docks are also located in the vicinity of the emergency spillway approach channel. These obstructions could reduce the ability of the structure to pass flows and this area should be reassessed by the engineer. There was standing water at the base of the emergency spillway, but it was assessed to be a topographic low that stores rainfall runoff. The elevation of this low area is at or below the downstream channel elevation and water at the base of the spillway appears to be permanent.

The hydrologic and hydraulic calculations performed by E. D'Appolonia were quite comprehensive and included all of the upstream dams. These dams included Brooks Lake, Lake Ariel, and Wildwood Lake. Other smaller impoundments were considered but were discounted in the analyses since the flow from these did not significantly affect the hydrology of the drainage area. The hydrology and hydraulic values used for this structure resulted in a design which would enable the dam to pass one-half of the PMF. Therefore, the spillway is considered to be "Inadequate".

b. Adequacy of Information. It is judged that the information available for the purpose of the prescribed inspection was adequate in terms of the hydrologic and hydraulic analyses. Other design calculations such as

slope stability, structural calculations, and construction testing were not available. There was sufficient documentation in the files to indicate that the construction was inspected by the design engineer and was performed in accordance with the designer's recommendations. The embankment configurations, which includes the slopes, crest width, freeboard, riprap and drainage features are reasonable and assumed adequate.

c. Urgency. It is considered that the recommendations presented below be implemented as soon as practical.

d. Necessity of Additional Studies. Although the data did not include summaries of stability analyses or structural calculations, the visual inspection of the embankment does not indicate that additional embankment studies are needed. The emergency spillway should be re-assessed because of the present use of the spillway approach channel as a marina.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following measures be undertaken. These recommendations are presented in order of priority.

1. In view of the obstructions in the approach channel, it is recommended that the emergency spillway be re-assessed. It is not recommended that the channel be used to store boats, trailers or serve as a parking lot.

2. The riprap discontinuity along the water's edge should be re-evaluated by a qualified engineer and rehabilitated in accordance with the engineer's recommendations.

3. It is recommended that the Owner contact a professional engineer and obtain a procedure for operating the two gates in the intake riser. Specifically, clarification should be obtained on when and how to use the eight-inch valve and how to operate the pond drain valve to satisfy minimum flow requirements.

4. Brooks Lake Dam and Wildwood Lake Dam should be assessed by a qualified engineer to assess the significance of the seepage and trees on the embankment, respectively.

5. Remove the boats and trailers in the emergency spillway.

b. Operation and Maintenance Procedures. The Owner should develop an operational procedure. The Owner should also develop a maintenance checklist to insure that all critical items are inspected on a periodic basis. Because of the location of the dam upstream of populated areas, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream residents that high flows will be experienced downstream from the dam. Particular emphasis should be given to the homes immediately around Lake Genero and the dwellings along the stream channel between Lake Genero and Lake Wallenpaupack.

APPENDIX

A

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Roaming Woods Lake Dam*

ID # *PA 00166*

ITEM	REMARKS
AS-BUILT DRAWINGS	*None However, DER files contained a set of 12 - design drawings on micro-film. Pertinent drawings are reporduced in Appendix E.*
REGIONAL VICINITY MAP	*None, but the lake can be found on USGS QUAD sheet entitled, "Lakeville, Penna.", photo revised 1973.*
CONSTRUCTION HISTORY	*There were no formal historical records available, but, by piecing together letters and other documentation, the basin construction sequence was reconstructed.*
TYPICAL SECTIONS OF DAM	*These are contained on the design drawings.*
OUTLETS - PLAN	*This data is presented on the design drawings.*
DETAILS	" " " " "
CONSTRAINTS	*None available*
DISCHARGE RATINGS	*This data is presented on the design drawings.*
RAINFALL/RESERVOIR RECORDS	*None available*

ITEM	REMARKS
DESIGN REPORTS	*Yes. "Design Calculations, Roaming Woods Lake, Wayne County, Pennsylvania" Project 69-138 by E. D'Appolonia, Pittsburgh, Pennsylvania, August, 1969. Document contains only hydrologic & hydraulic data. There were no geotechnical or structural calculations available.*
GEOLOGY REPORTS	*None*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS	*Yes. See "Design Reports" above.*
DAM STABILITY SEEPAGE STUDIES	*This data was not available*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*This was performed by E. D'Appolonia, Consultant Engineers, Pittsburgh, Pennsylvania. This data was in their archives and could not be retrieved in time for review.*
POST-CONSTRUCTION SURVEYS OF DAM	*None available or known.*
BORROW SOURCES	*See "Design Drawings" by D'Appolonia*

ITEM	REMARKS
MONITORING SYSTEMS	*None. A weir was to be constructed downstream of the spillway to monitor flow but it was not found during the on-site inspection.*
MODIFICATIONS	*None Known*
HIGH POOL RECORDS	*None*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*None*
MAINTENANCE OPERATION RECORDS	*Yes. A letter report entitled "Lake Management, Roaming Woods Lake", dated July, 1973, Project NO. 73-527 by E. D'Appolonia discusses operation and maintenance.*

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	*See "Design Drawings" by E. D'Appolonia*
DETAILS	*" " "*
OPERATING EQUIPMENT PLANS & DETAILS	*See "Design Drawings" by E. D'Appolonia* *" " "*
OTHER DOCUMENTS	*A report of construction documents dated Oct. 15, 1974, Project 71-349-A for "Improvements and Modifications for Brooks Lake" were also reviewed. This is a lake upstream of Roaming Woods Lake.*

APPENDIX

B

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam *Roaming Woods Lake Dam* County *Wayne* State *Pennsylvania* National ID # *PA 00166*

Type of Dam *Rolled Earth* Hazard Category *I (High)*

Date(s) Inspection *29 June 1978* Weather *Cloudy & Humid* Temperature *70's °F*

Pool Elevation at Time of Inspection *1324.0* M.S.L. Tailwater at Time of Inspection *1301.0* M.S.L.

Inspection Personnel:

Mary Beck (Hydrologist) *Vince McKeever (Hydrologist)*

John Boschuk, Jr. (Geotechnical/Civil)

Brady Bisson (Geotechnical)

John Boschuk, Jr. Recorder

Remarks:

Mr. Fred Courtright, Community Engineer for Hideout Property Owner Associates, Inc. was the Owner's representative during the inspection.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*N/A*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*N/A*	
DRAINS	*N/A*	
WATER PASSAGES	*N/A*	
FOUNDATION	*N/A*	

CONCRETE/MASONRY DAMS

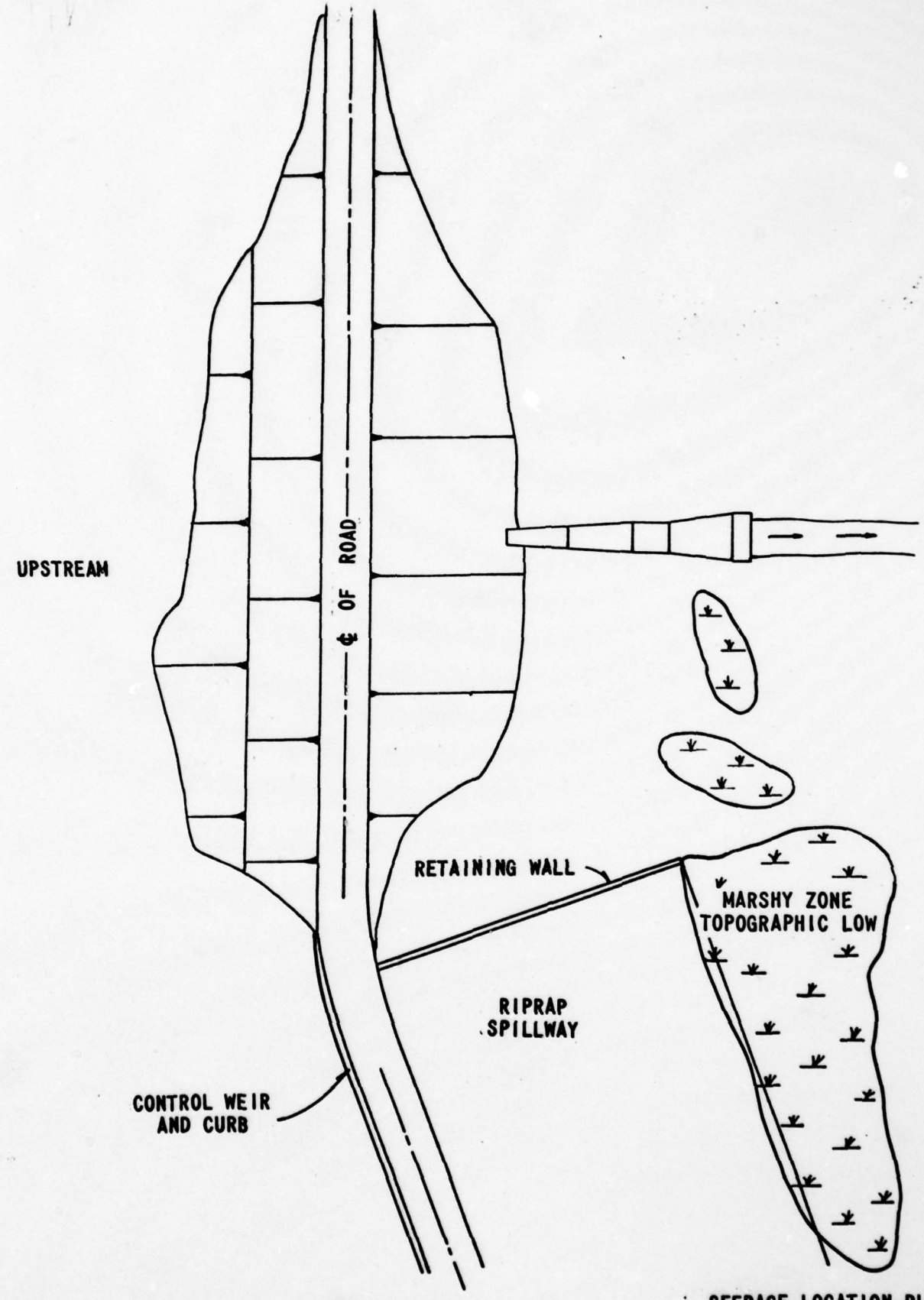
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	*N/A*	
STRUCTURAL CRACKING	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT	*N/A*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*N/A*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*None observed.*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*None observed.*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*A slight amount of erosion was noted along the embankment junction with the left abutment but it is not considered significant. A small amount of erosion was observed on the upstream slope immediately above the riprap. Several small animal holes were observed on the upstream face of the embankment.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*Alignment appeared to be good with the exception of guard rail alignment. Guard rails exhibited a slight localized curvature towards the lake near the dam mid-point on the edge at the upstream slope and a slight localized curvature near the left abutment on the edge of the downstream slope. A maximum deflection of approximately 3 inches was observed.*	
RIPRAP FAILURES	*Riprap along the upstream face appears to have been washed down the slope below the water level due to wave action. The riprap generally appeared to be small, generally less than 12 inches nominal dimension. Also, the riprap did not extend the full height of the embankment and some soil erosion was noted immediately above the riprap. It was also noted that very little riprap existed on the upstream face near the left abutment.*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*No deficiencies observed.*	
ANY NOTICEABLE SEEPAGE	*The downstream toe of the emergency spillway has standing water and cattails. Two isolated wet zones between the spillway toe and principal discharge system were observed. Flow was not observed in these areas. See sheet 5 a.*	
STAFF GAGE AND RECORDER	*None functional. A staff gage was observed attached to the intake riser, but the inspection team was told it was never used. The numbers were faded and not readily legible.*	
DRAINS	*No surface drains and no exterior evidence of malfunctioning interior drains were observed.*	



SEEPAGE LOCATION PLAN
ROAMING WOODS LAKE DAM

SHEET 5a OF 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*None observed*	
INTAKE STRUCTURE	*The intake structure consists of 2-16 foot weirs, a 36 inch sluice gate and an 8 inch pipe outlet. The weirs were clean with only minor accumulations of trash. The valves were exercised and operated properly. The structure appeared to be in excellent condition.*	
OUTLET STRUCTURE	*Concrete surfaces were in generally good condition. One crack was observed at the end of the left spillway wall at the junction with the wing wall. The discharge conduit is a five feet-six inch diameter concrete pipe. Maximum flow of this pipe is 660 cfs.*	
OUTLET CHANNEL	*The channel appears to be stable and in good condition. The concrete section is 75 feet long, 12 feet wide at the lower end and 7 1/2 feet deep.*	
EMERGENCY GATE	*None*	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*Good condition. 226 foot concrete sill approximately 15 inches above paved road and parking lot serves as the control weir.*	
APPROACH CHANNEL	*The 255 foot asphalt paved channel is being used as a boat launch and parking lot (Main Marina). The channel is full of boats, trailers and cars. The area also contains boat houses, vending machines and sanitary facilities together with decorative rocks ranging up to 5 or 6 feet in diameter. It is possible that lighter boats and canoes will float over the weir and drop out on the road or discharge channel and, along with obstructions in the parking lot, reduce discharge of flood water.*	
DISCHARGE CHANNEL	*This channel is in relatively good condition but woody growth is beginning to develop. This growth should be removed. The channel is sloped at 6 1/2 degrees. The left side of the channel is protected with a concrete retaining wall.*	
BRIDGE AND PIERS	*None*	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*NONE*	
APPROACH CHANNEL	*NONE*	
DISCHARGE CHANNEL	*NONE*	
BRIDGE AND PIERS	*NONE*	
GATES AND OPERATION EQUIPMENT	*NONE*	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*NONE*	
OBSERVATION WELLS	*NONE*	
WEIRS	*NONE*	
PIEZOMETERS	*NONE*	
OTHER	*NONE*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*Moderate slopes, well vegetated with grass and trees to the water's edge. Homes surround the lake.*	
SEDIMENTATION	*There is no evidence of sedimentation. A few small logs are in evidence but this is not likely to interfere with flows and flood storage is not likely to be decreased in the forseeable future.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*Channel is stable and trees are growing in the floodplain. Some debris is in the channel. The water level will be approximately 15 feet below the dam during the passing of the PMF.*	
SLOPES	*The average gradient between the dam and head waters of Lake Wallenpaupack is 0.6 percent*	
APPROXIMATE NO. OF HOMES AND POPULATION	*There are approximately 12 to 15 homes around Lake Genero, about 3/4 mile below the dam. Other damages in case of failure would be to roads, 5 highway bridges and a few scattered homes. Some damage will occur at about 3500 cfs discharge.*	

APPENDIX

C

Roaming Woods Lake Dam
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *Approx. 50% wooded and 10% lakes, ponds or marshes*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *1324.0 (2249 Ac-Ft)*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *1324.0 (2894 Ac-Ft)*

ELEVATION MAXIMUM DESIGN POOL: *1328.0*

ELEVATION TOP DAM: *1331.5*

EMERGENCY SPILLWAY:

a. Elevation *1327.0*

b. Type *Concrete curb*

c. Width *N/A*

d. Length *228 feet effective length*

e. Location Spillover *Right abutment*

f. Number and Type of Gates *None*

PRINCIPAL SPILLWAY:

a. Type *Reinforced concrete drop inlet and 66 inch conduit*

b. Location *Upstream of embankment*

c. Entrance inverts *1324 ungated*

d. Exit inverts *1301.1*

e. Emergency draindown facilities *36 inch pond drain*

HYDROMETEOROLOGICAL GAGES:

a. Type *None*

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: *Not computed*

Roaming Woods Lake Dam
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *Approx. 50% wooded and 10% lakes, ponds or marshes*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *1324.0 (2249 Ac-Ft)*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *1324.0 (2894 Ac-Ft)*

ELEVATION MAXIMUM DESIGN POOL: *1328.0*

ELEVATION TOP DAM: *1331.5*

EMERGENCY SPILLWAY:

a. Elevation *1327.0*

b. Type *Concrete curb*

c. Width *N/A*

d. Length *228 feet effective length*

e. Location Spillover *Right abutment*

f. Number and Type of Gates *None*

PRINCIPAL SPILLWAY:

a. Type *Reinforced concrete drop inlet and 66 inch conduit*

b. Location *Upstream of embankment*

c. Entrance inverts *1324 ungated*

d. Exit inverts *1301.1*

e. Emergency draindown facilities *36 inch pond drain*

HYDROMETEOROLOGICAL GAGES:

a. Type *None*

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: *Not computed*

DAM SAFETY ANALYSIS
HYDROLOGIC/HYDRAULIC DATA

Date: 7/24/78
By: MB
Sheet 2 of 9

DAM Roaming Woods Lake Dam Nat. ID No. PA 00166 DER No. 64-191

	ITEM/UNITS	Permit/Design Files (A)	Calc. from Files/Other (B)	Calc. from Observations (C)
1.	Min. Crest Elev., ft.	1331.5 ft		
2.	Freeboard, ft.			
3.	Spillway(1) Crest Elev, ft.	1324.0 ft		
3a.	Secondary(2) Crest Elev, ft.	1327.0		
4.	Max. Pool Elev., ft.			
5.	Max. Outflow(3), cfs	8312 cfs		
6.	Drainage Area, mi^2	9.63 mile^2		9.65 mile^2
7.	Max. Inflow(4), cfs	10,350 cfs		
8.	Reservoir Surf. Area,	205 Ac.		
9.	Flood Storage(5), ft^3	1842 Ac-Ft		
10.	Inflow Volume, ft^3			

Reference all figures by number or calculation on attached sheets:

Example: 3A - Drawing No. xxx by J. Doe, Engr., in State File No. yyyy.

NOTES:

(1) Main emergency spillway.

(2) Secondary ungated spillway.

(3) At maximum pool, with freeboard, ungated spillways only.

(4) For B, C, use PMF.

(5) Between lowest ungated spillway and maximum pool.

Date: 7/24/78
By: MB
Sheet 3 of 9

HYDROLOGIC/HYDRAULIC CALCULATIONS (cont.)

Item (from Sheet 2)	Source
1A, 3A, 3aA,	Construction Drawings dated
5A, 6A, 7A, 8A, 9A	Design Calculations, dated Aug. 1969
6C,	USGS Maps Lakeville (1973) Lake Ariel (1973)

Classification (Ref. Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as HIGH as there would be loss of life if the dam failed.

2. The size classification is intermediate based on its storage of 4090 Ac-Ft (to the top of the dam).

3. Spillway design flood, based on size and hazard classification, is the probable maximum flood (PMF).

Hydrology and Hydraulics Analysis

1. Original Data from Report titled "Design Calculations, Roaming Wood Lake", E. D'Appolonia Consulting Engineers, Inc., Pittsburg, PA., August 1969. The following were taken from the design reports

sheet	5	Hydrological Scheme
sheet	6	Hydrological Basic Data
sheet	7	Hydrology
sheet	8	Spillway Rating Curve
sheet	9	Inflow Hydrograph

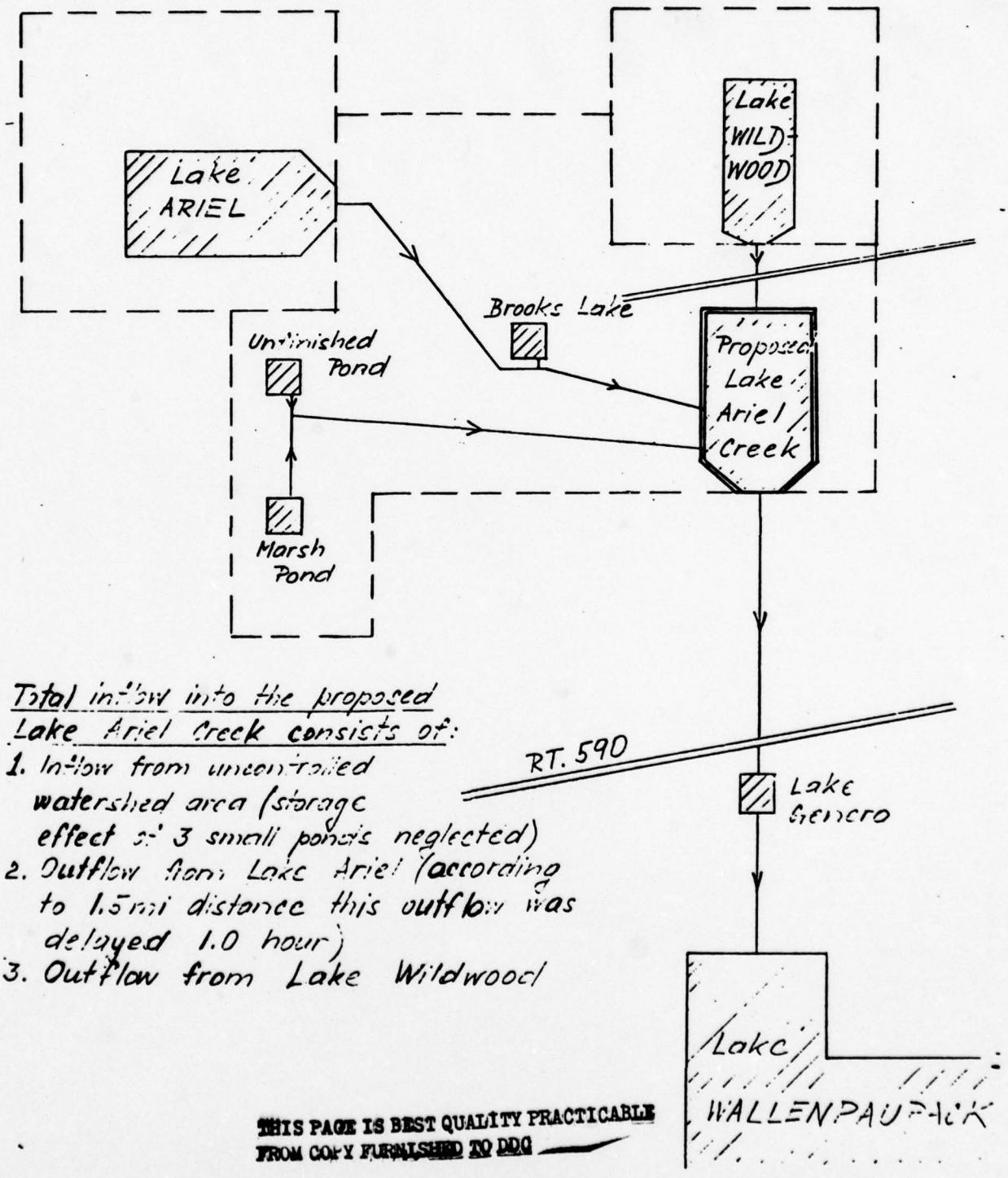
2. Evaluation of Original Data. The H&H design was performed using procedures developed by the Soil Conservation Services. The basis criteria is contained in the SCS Engineering Memo #27. Based on original design assumptions, the design is complete and judged accurate. Sheet 7 indicates the structure classification is (b). A structure classification (b) corresponds to a "Significant" and is designed for 0.5 PMF.

Therefore, the spillway system is judged "Inadequate" but not "Seriously Inadequate".

E. D'APPOLONIA CONSULTING ENGINEERS, INC.

BY LT DATE 8/5/69 SUBJECT Ariel Creek SHEET NO. 4 OF

CHKD. BY RBJ DATE 8/16/69 Hydrological scheme PROJ. NO.



Total inflow into the proposed Lake Ariel Creek consists of:

1. Inflow from uncontrolled watershed area (storage effect of 3 small ponds neglected)
2. Outflow from Lake Ariel (according to 1.5 mi distance this outflow was delayed 1.0 hour)
3. Outflow from Lake Wildwood

Lake	Normal Lake Level	Lake area		Watershed Area					Hydrograph: Em. Spillway Maximal Inflow 2)		Hydrograph: Freeboard Maximal Inflow 2)		Remarks
				Area		Sp. ar.	Max. w.path	Δh					
	ft	10^6 ft^2	acres	mi^2	acres	1)	mi	ft	sec-ft	sec-ft/mi^2	sec-ft	sec-ft/mi^2	
Ariel	1426	10.32	237	3.42	2187	9.2	2.8	184	2250 (378.6)	234 (111)	5660 (1157) [3765]	1948 (338) [1100]	5)
Wildwood	1361	3.84	88	2.06	1321	15.1	2.2	265	2260 (634.8)	1095 (303)	5580 (1913) [2570]	2710 (930) [1250]	5)
Ariel Creek (proposed) *)	1324	8.94	205	9.63	6162	30.0	4.8	340	3225	335	8300 [7700]	861 [800]	*) Total data
Ariel Creek **)				4.15	2654	12.9	6.0	260	2500	602	6150 [4310]	1481 [1040]	**) Uncontrolled watershed area only

Basic hydrological data:

			Hydrograph: Em. sp.	Hydrograph: Freeboard	Hydrograph: 100-y. storm
Accumulative rainfall of duration 30 hours 3)	6 hours	inches	7.0	12.5	4.9
	12 "		8.5	15.2	6.0
	24 "		10.3	18.4	7.2
	30 "		10.9	19.5	7.6
Curve number for runoff calculation 4)			70	70	70

Remarks:

1) Specific Area = $\frac{\text{Watershed Area}}{\text{Lake Area}}$ (Determined according to the USGS 7½ min. map)

2) Specific Maximal Inflow [sec-ft per sq mi] = $\frac{\text{Maximal Inflow [sec-ft]}}{\text{Watershed Area [sq mi]}}$

3) Engineering Memo. No 27 (March 19, 1965) - U.S. Department of Agriculture (S.C.S.)

4) Design of Small Dams (pg. 426) - Bureau of Reclamation

5) Data in brackets: [ ]: Flow according to curve "c" (Pa. Dept. of Forests and waters)
( ): Inflow into the proposed lake affected by respective reservoir storages and spillway capacities.

BY JAM DATE 4/6/71 SUBJECT LAKEVILLE LAKES SHEET NO 13 OF ____
CHKD. BY LBP DATE 4/13/71 LAKE ARIEL - HYDROLOGY PROJ. NO. 69-132

REF: U.S. DEPT OF AGRICULTURE - ENGINEERING MEMO - 27- EARTH DAMS

1) STRUCTURE CLASS (b)

DATA FOR DESIGN (ES 1020, SHEETS 2 & 3)

2) MIN 6-HR PRECIPITATION FOR SPILLWAY HYDROGRAPH... 12.5 INCHES

HOURLY RAINFALL (ES 1003, SH #1)

TIME HOURS	PERCENT 6-HR RAIN	RAIN FOR FREEBOARD RUNOFF		FREEBOARD RUNOFF		LOSS
		ACC	INCR	ACC.	INCR.	INCR.
		INCHES		INCHES		
1	8	1.0	1.0	0	0	1.0
2	23	2.9	1.9	0.7	0.7	1.2
3	70	8.7	5.8	5.1	4.4	1.4
4	84	10.5	1.8	6.7	1.6	0.2
5	93	11.6	1.1	7.7	1.0	0.1
6	100	12.5	0.9	8.5	0.8	0.1
12	122	15.2	2.7	10.9	2.4	0.3
24	147	18.4	3.2	13.5	2.6	0.6
36	165	20.6	2.2	15.1	1.6	0.6

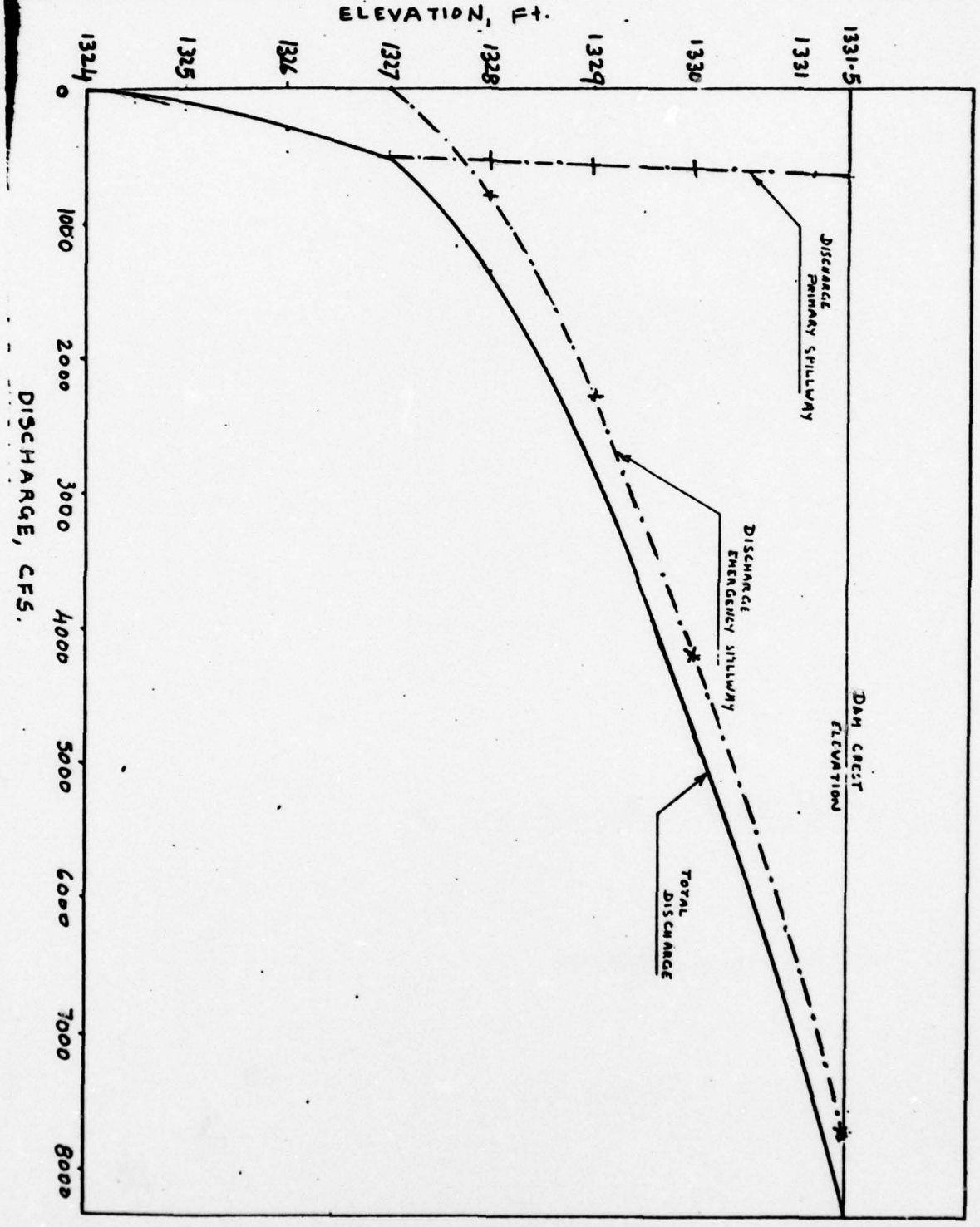
SOIL IN WATERSHED AREA (PAPAKATING, CHIPPEWA, & LOCKPORT) BELONGS TO HYDROLOGIC GROUP "C" WITH FAIR CONDITIONS FOR INFILTRATING. GROUND SURFACE WILL BE COVERED BY WOODS: Number of curve "70" (pg. 427-430 Design of S.D.) The soils belong to group C, but their properties are close to border with group B (fig. A-1, pg. 425).

MINIMUM CONSTANT INFILTRATION 0.05 IN/HR (FIG. 21)
- MIN. INCREMENTAL LOSS .6 IN PER 12 HR.

E. D'APPOLONIA CONSULTING ENGINEERS, INC.

BY ___ DATE ___ SUBJECT Reel Creek SHEET NO 7 OF ___

CHKD. BY RBP DATE 5/16/69 PROJ. NO. 69-13

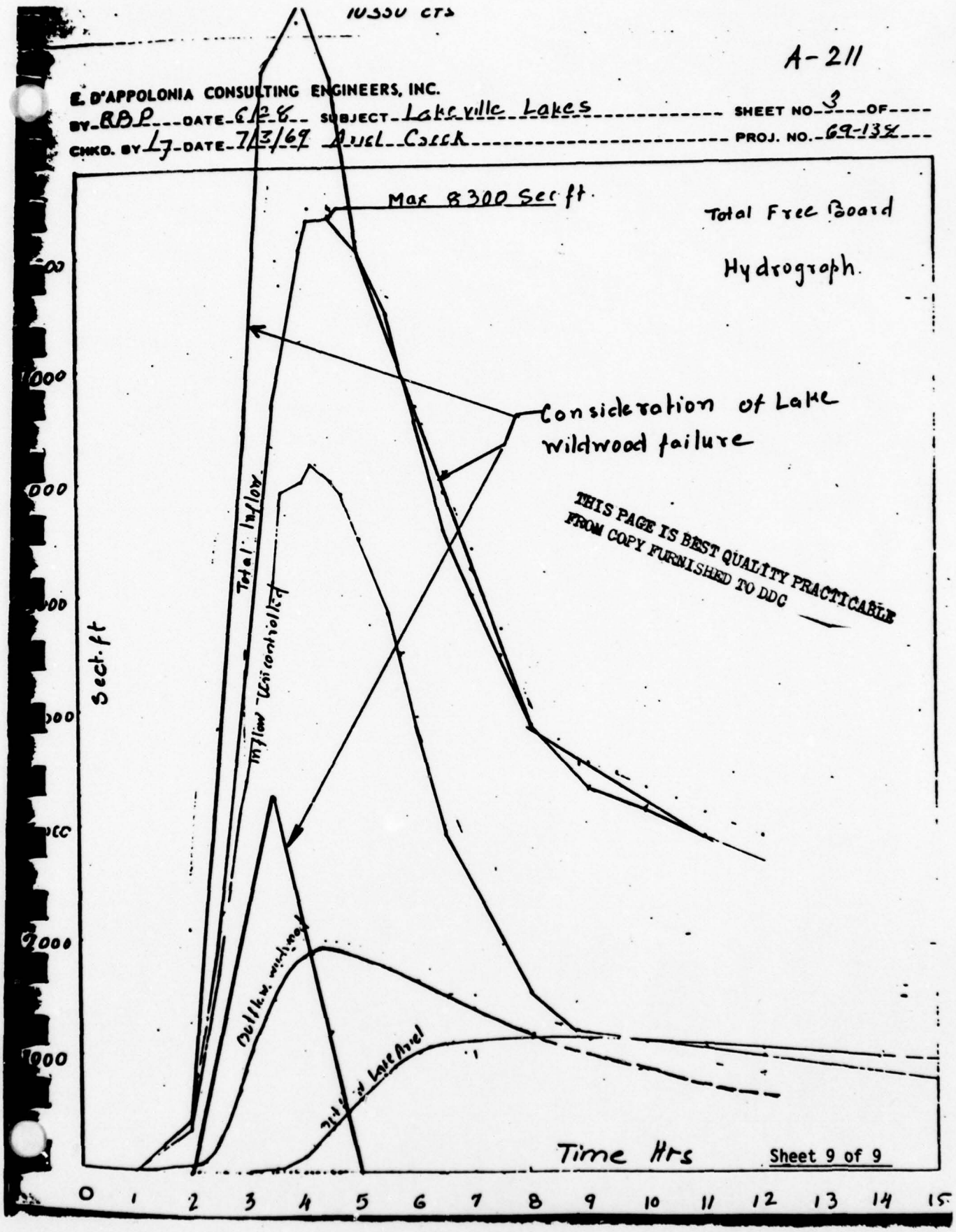


A-211

E. D'APPOLONIA CONSULTING ENGINEERS, INC.

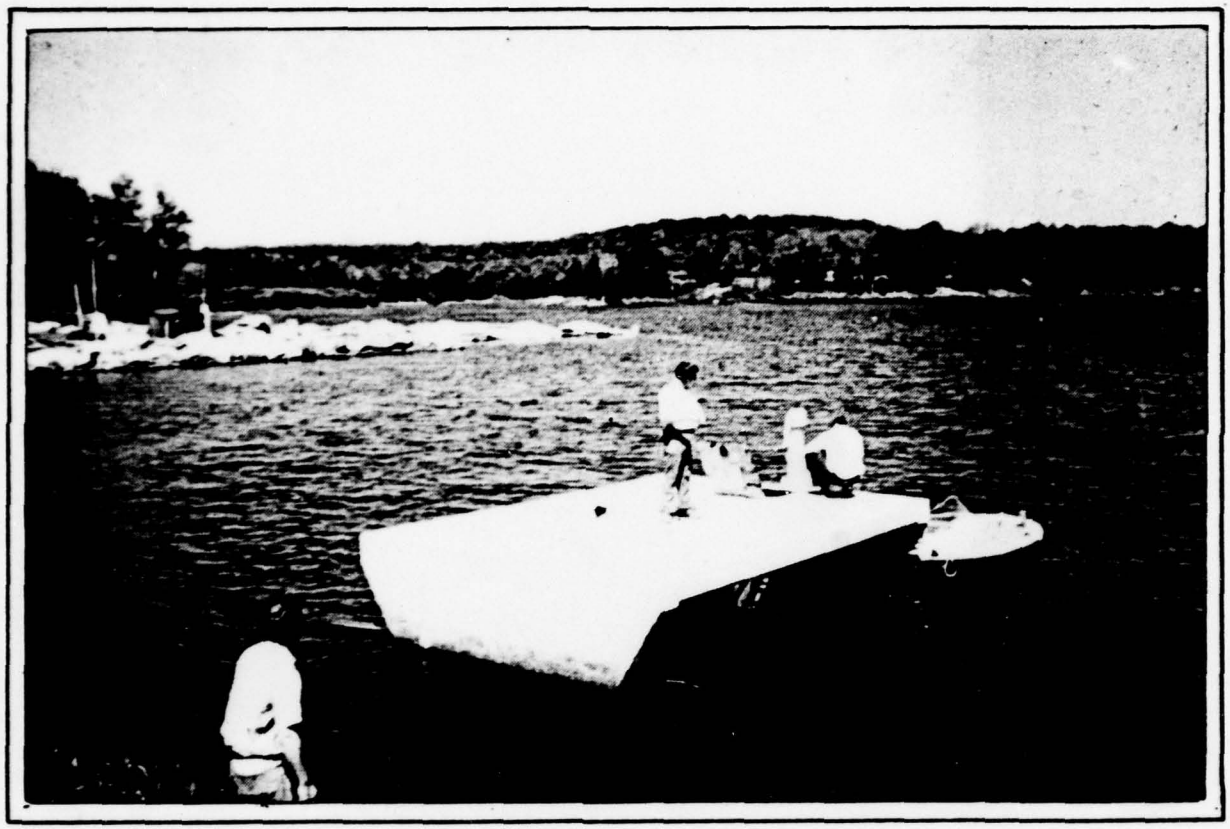
BY RBP DATE 6/26 SUBJECT Lakeville Lakes SHEET NO. 3 OF

CHKD. BY LJ DATE 7/3/69 Duck Creek PROJ. NO. 69-135



APPENDIX

D

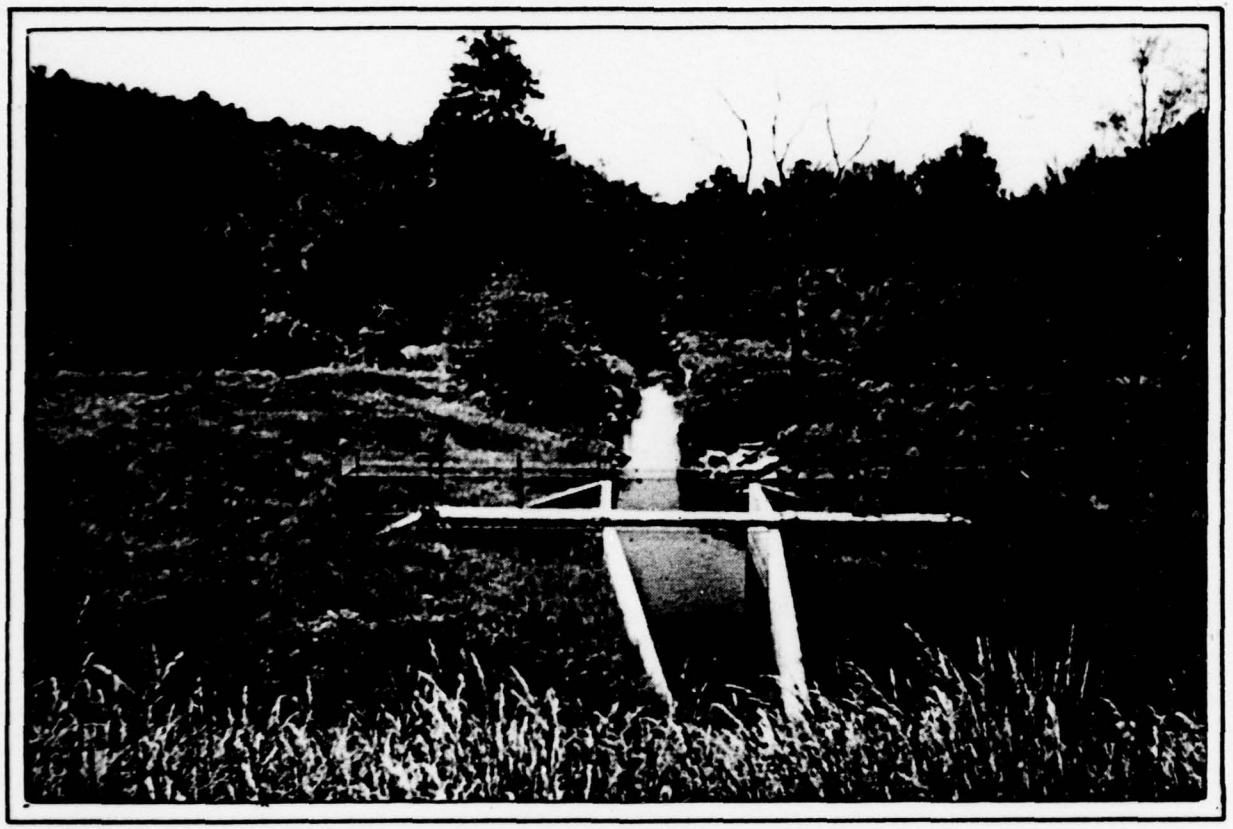


VIEW OF PRINCIPAL INTAKE STRUCTURE.
NOTE WEIR AND POND DRAIN VALVE.

PHOTOGRAPH NO. 1

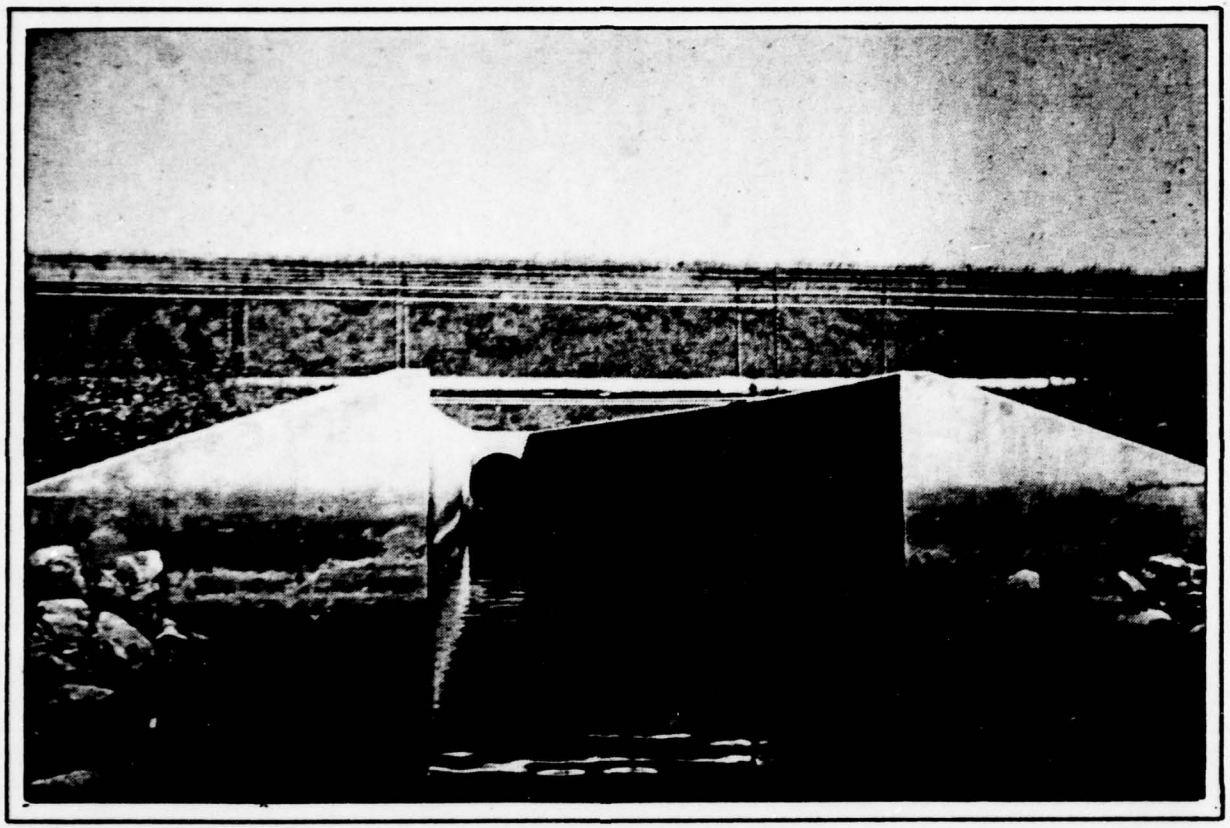
VIEW OF POND DRAIN VALVE.

PHOTOGRAPH NO. 2



VIEW FROM DAM CREST LOOKING TOWARDS STILLING BASIN. WATER PIPES CROSS THE BASIN.

PHOTOGRAPH NO. 3



VIEW LOOKING UPSTREAM INTO STILLING
BASIN. NOTE HIGH WATER MARKS ON
THE WING WALLS.

PHOTOGRAPH NO. 4

VIEW OF EMERGENCY APPROACH CHANNEL.
NOTE BOATS AND OTHER OBSTRUCTIONS
IN PARKING AREA.

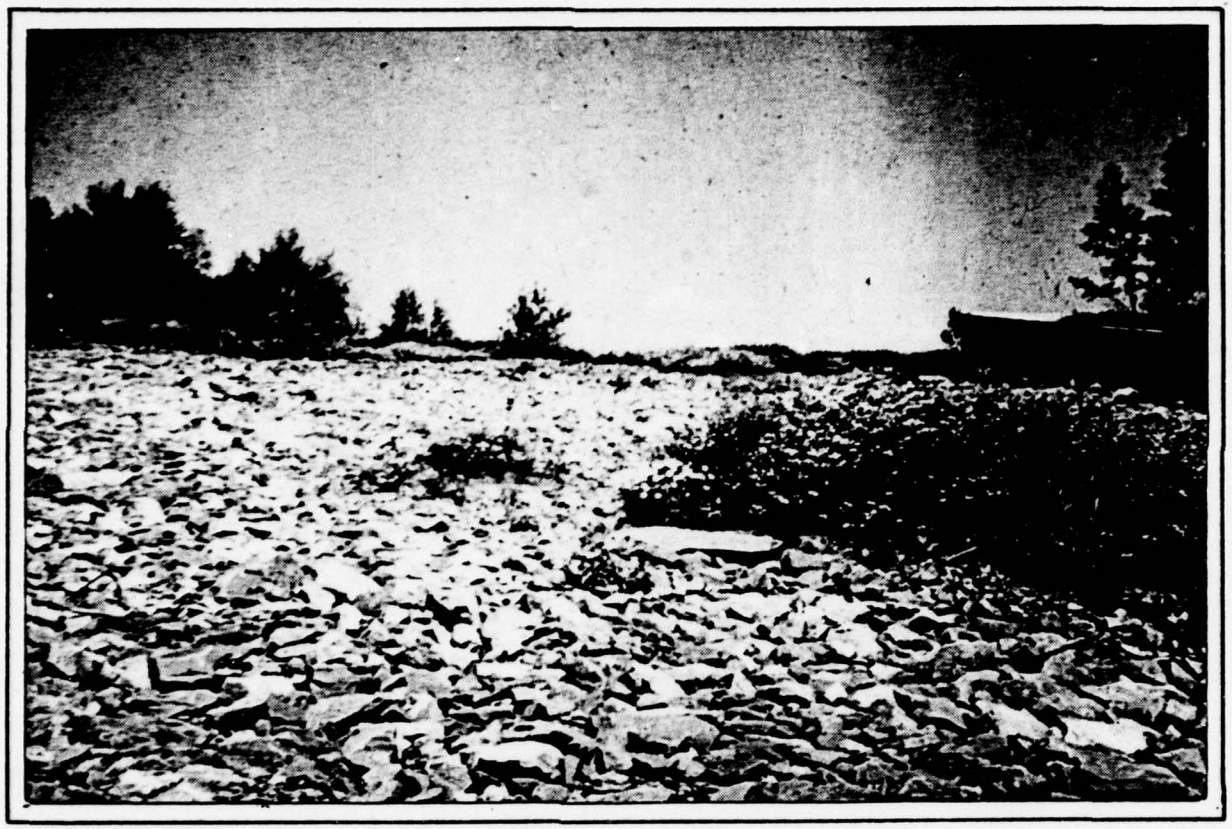
PHOTOGRAPH NO. 5

VIEW OF EMERGENCY SPILLWAY CONTROL SECTION LOOKING TOWARDS RIGHT ABUTMENT.

PHOTOGRAPH NO. 6

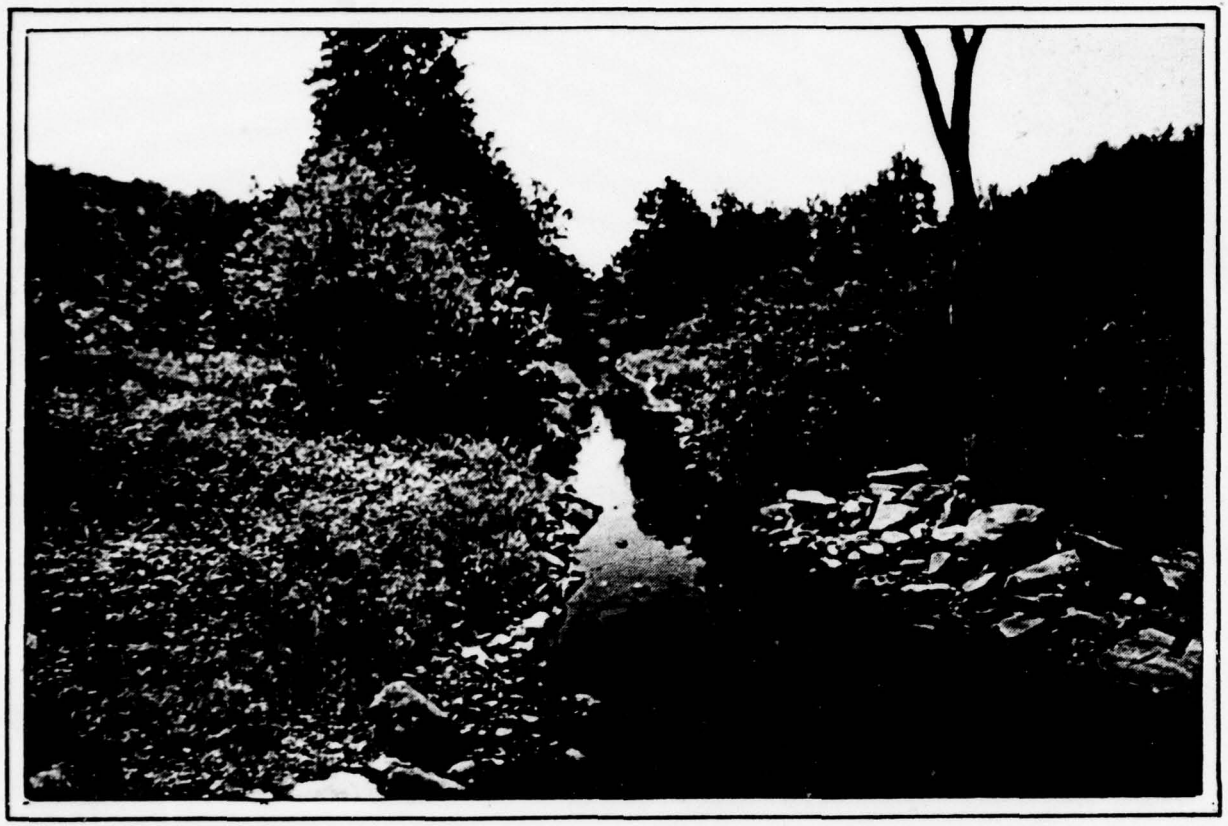
LOOKING DOWN THE EMERGENCY SPILLWAY.
NOTE RETAINING WALL WHICH SEPARATES
THE SPILLWAY FROM THE EMBANKMENT.

PHOTOGRAPH NO. 7



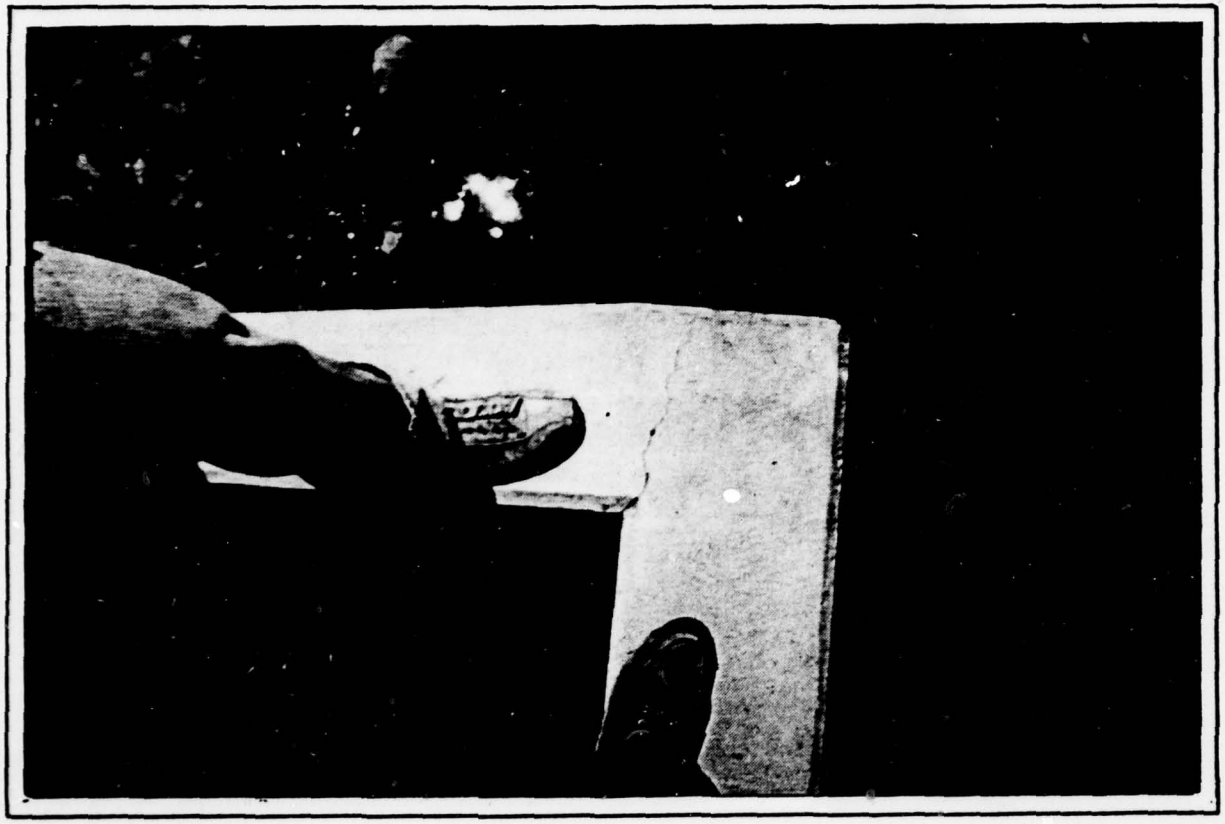
RIPRAP PAVING OF EMERGENCY SPILLWAY DOWNSTREAM OF THE CREST (LOOKING UPSTREAM).

PHOTOGRAPH NO. 8



VIEW OF CHANNEL DOWNSTREAM OF THE STILLING BASIN. THE EMERGENCY SPILL-WAY DISCHARGES ON THE RIGHT SIDE OF THE STREAM.

PHOTOGRAPH NO. 9



MINOR CRACKING OF LEFT WING WALL.

PHOTOGRAPH NO. 10

VIEW OF OBSTRUCTIONS IN THE EMERGENCY SPILLWAY.

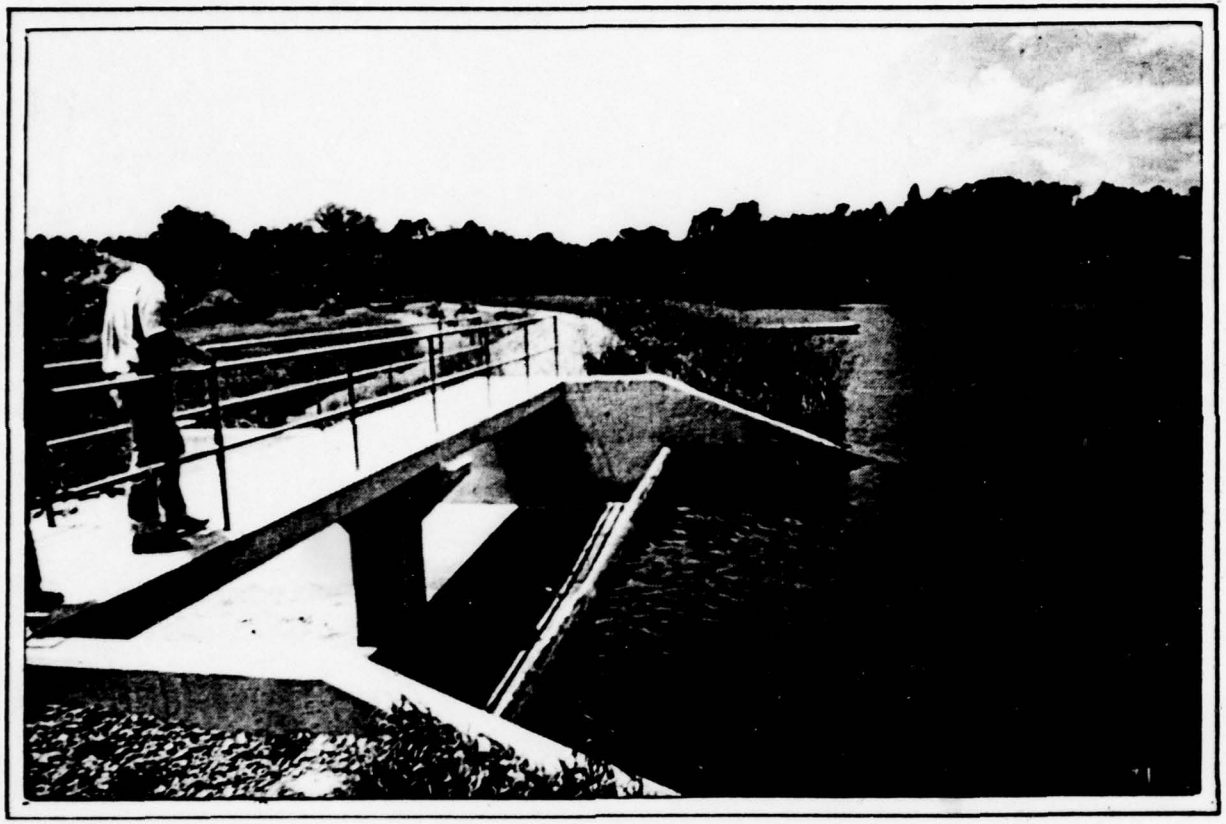
PHOTOGRAPH NO. 11

OVERVIEW OF WILDWOOD LAKE DAM. THE DAM IS LOCATED UPSTREAM OF ROAMING WOODS LAKE DAM. BOTH THE UP- AND DOWNSTREAM SLOPES ARE COVERED WITH TREES.

PHOTOGRAPH NO. 12

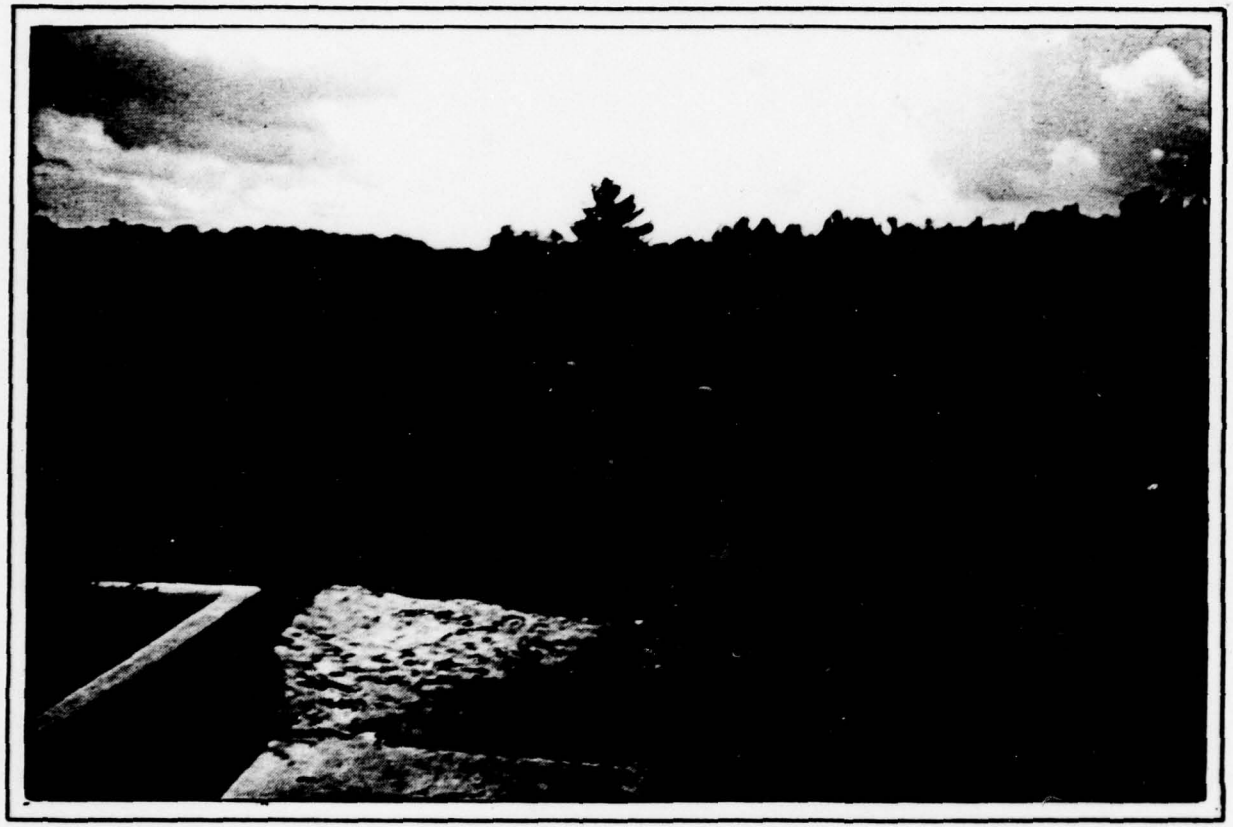
OVERVIEW OF DEERFIELD LAKE DAM
AND SPILLWAY.

PHOTOGRAPH NO. 13



OVERVIEW OF BROOKS LAKE DAM AND
SPILLWAY.

PHOTOGRAPH NO. 14



BROOKS LAKE SPILLWAY. SEEPAGE WAS
NOTED UNDER THE SPILLWAY CHANNEL
AND ALONG THE TOE OF THE EMBANKMENT.

PHOTOGRAPH NO. 15

APPENDIX

E

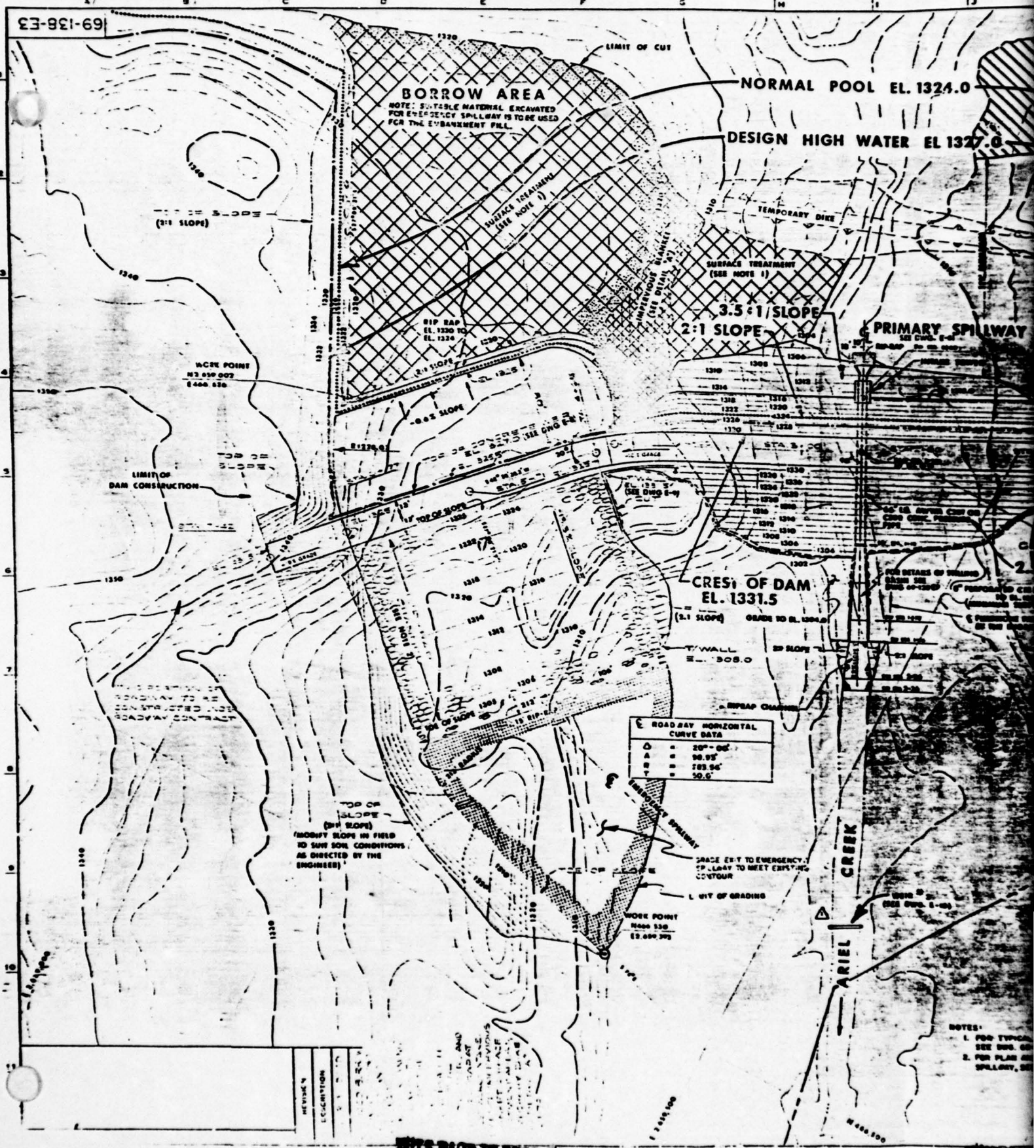
REGIONAL LOCATION PLAN

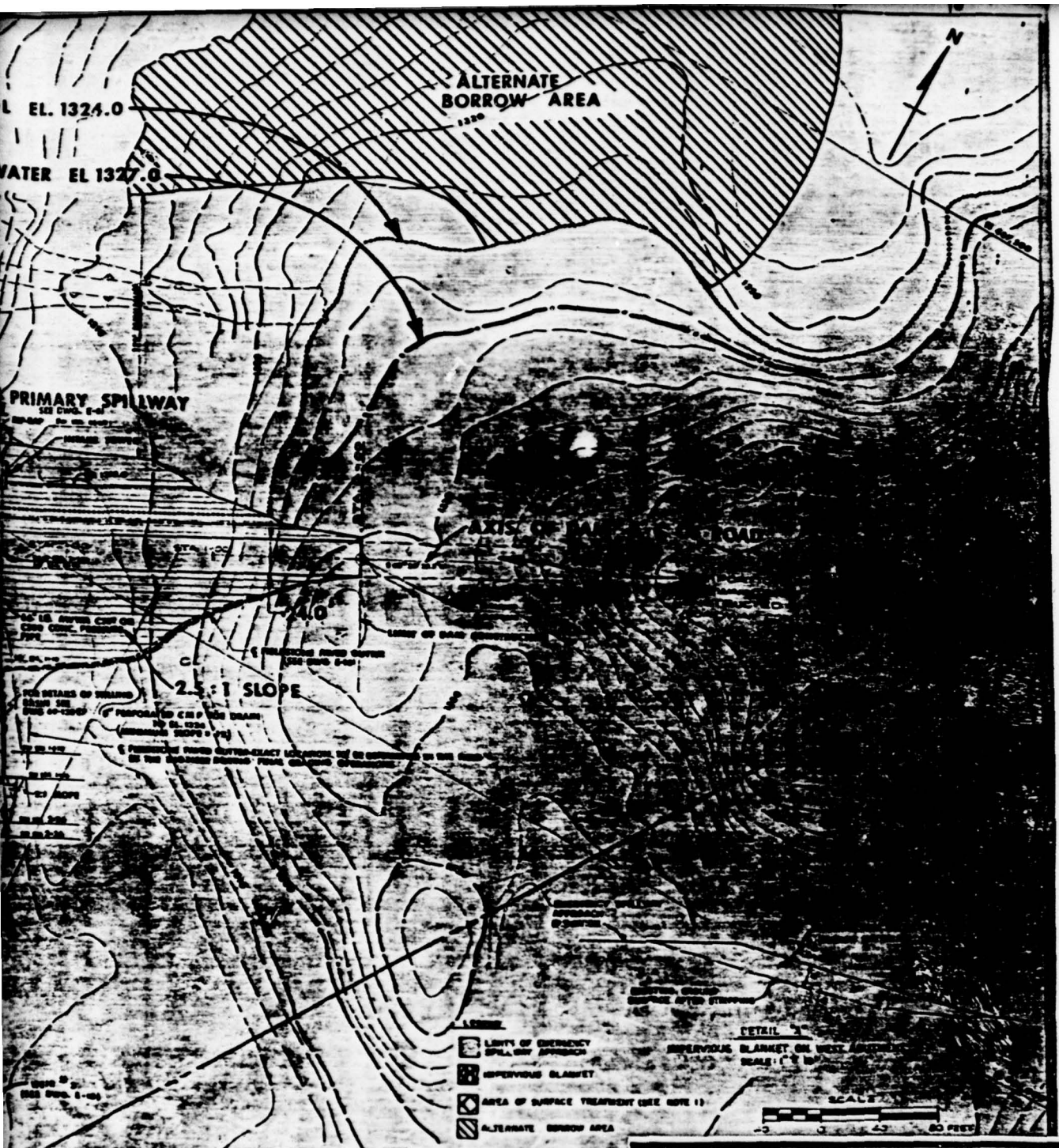
ROAMING WOODS LAKE DAM

NAT.ID NO. PA.00166 **WAYNE COUNTY**

DATA OBTAINED FROM U.S.GEOLOGICAL SURVEY QUAD SHEET ENTITLED LAKEVILLE, PENNA. REV.1973

PLATE 1





PLAN OF DAM AND APPURTENANCES

ROAMING WOODS LAKE DAM

NAT.ID NO. PA.00166 WAYNE COUNTY

DATA OBTAINED FROM E. D'APPOLONIA CONSULTING ENGINEERS, DRAWING NO. 69-138-E3, DATED AUGUST, 1967

PLATE 2

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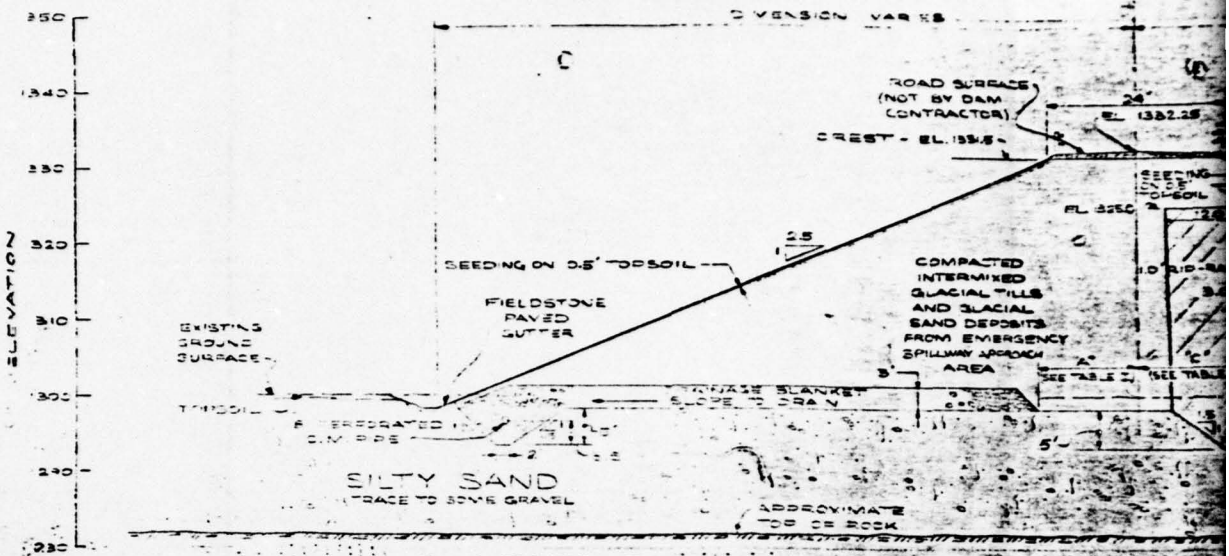
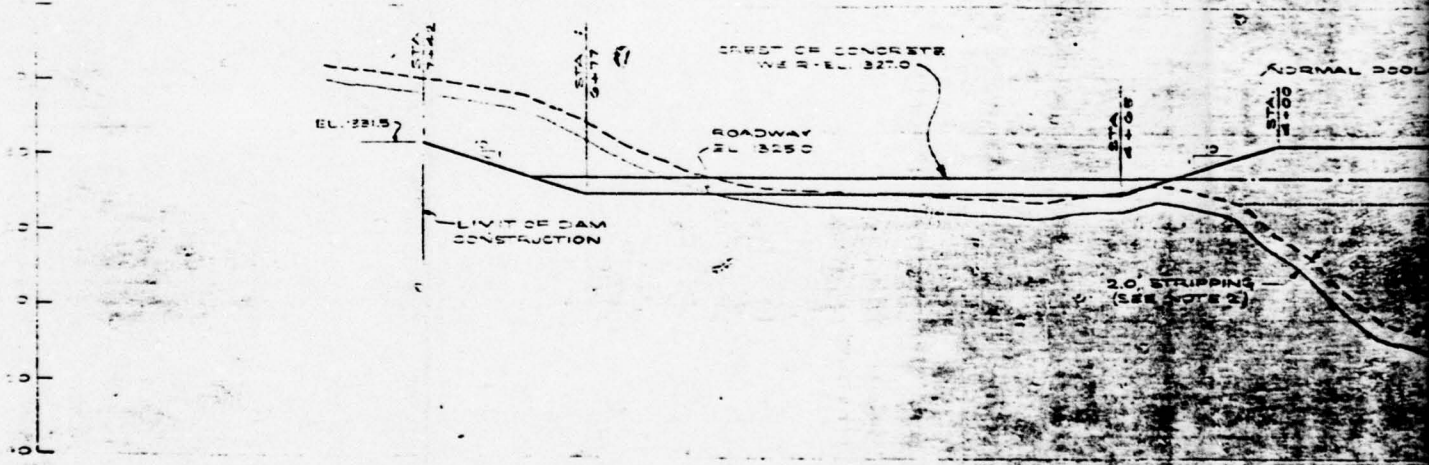


TYPICAL TRANSVERSE

SCALE: 1" = 10'



LONGITUDINAL SECTION AT ℄

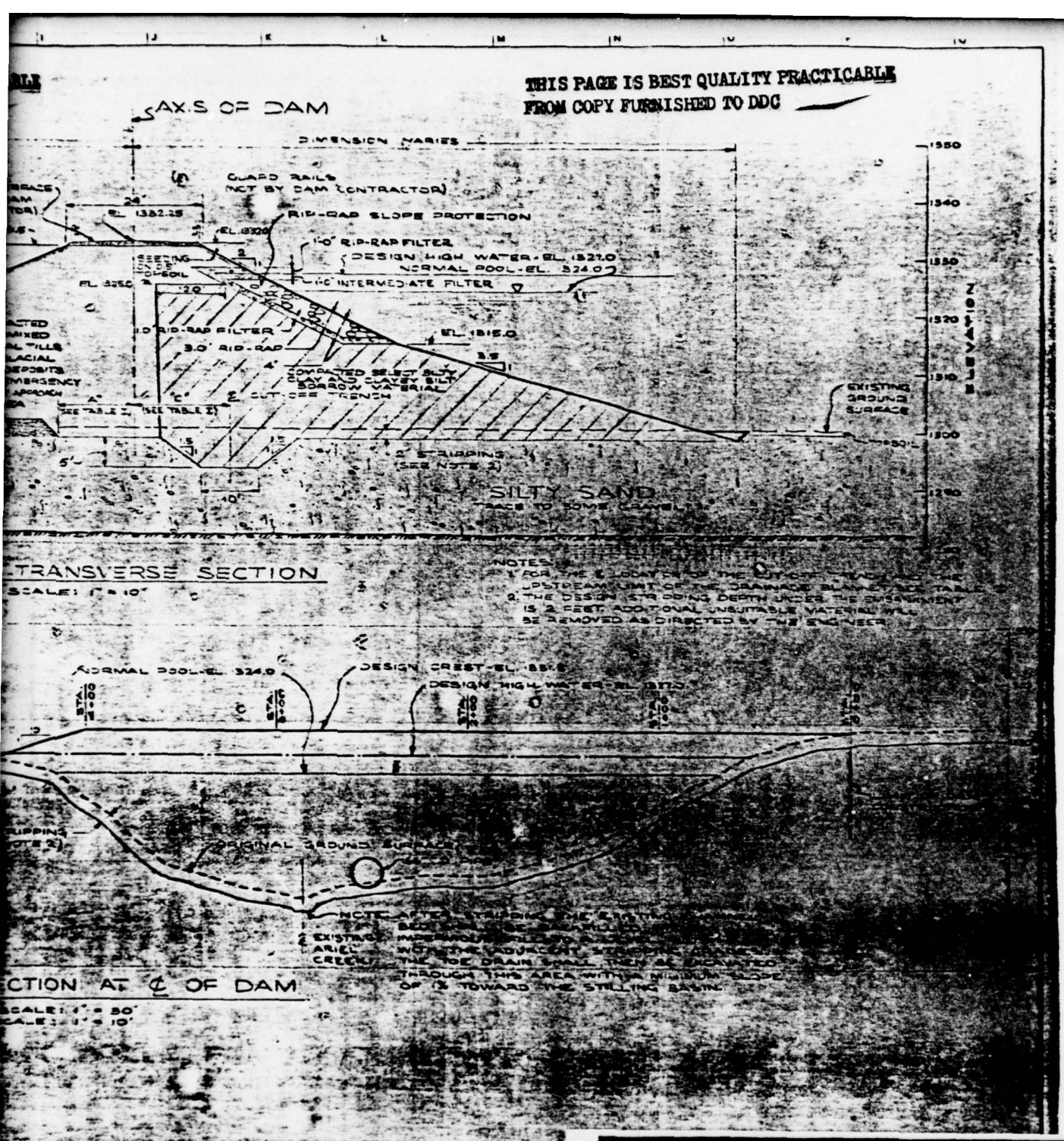
HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'

TABLE II

DAM STATION	DRAINAGE BLANKET DIVENSION "A" (FT)	CUT-OFF TRENCH DIMENSION "C" (FT)
0+35	0	0
1+00	4.0	7.5
1+50	8.0	11.5
2+00	10.0	13.5
2+50	11.0	14.0
3+00	12.0	15.0
3+50	10.0	13.0
4+00	4.0	7.0
4+50	0	0

REVISION | DESCRIPTION

REFERENCE DRAWINGS



TRANSVERSE SECTION
SCALE: 1" = 10'

NOTES:
1. FOR THE LOCATION OF THE CUT-OFF TRENCH AND THE UPSTREAM LIMIT OF THE DRAINAGE BLANKET SEE TABLE
2. THE DESIGN STRIPPING DEPTH UNDER THE EMBANKMENT IS 2 FEET. ADDITIONAL UNSUITABLE MATERIAL WILL BE REMOVED AS DIRECTED BY THE ENGINEER

CTION AT ℄ OF DAM
SCALE: 1" = 50'
SCALE: 1" = 10'

TYPICAL EMBANKMENT AND LONGITUDINAL SECTIONS

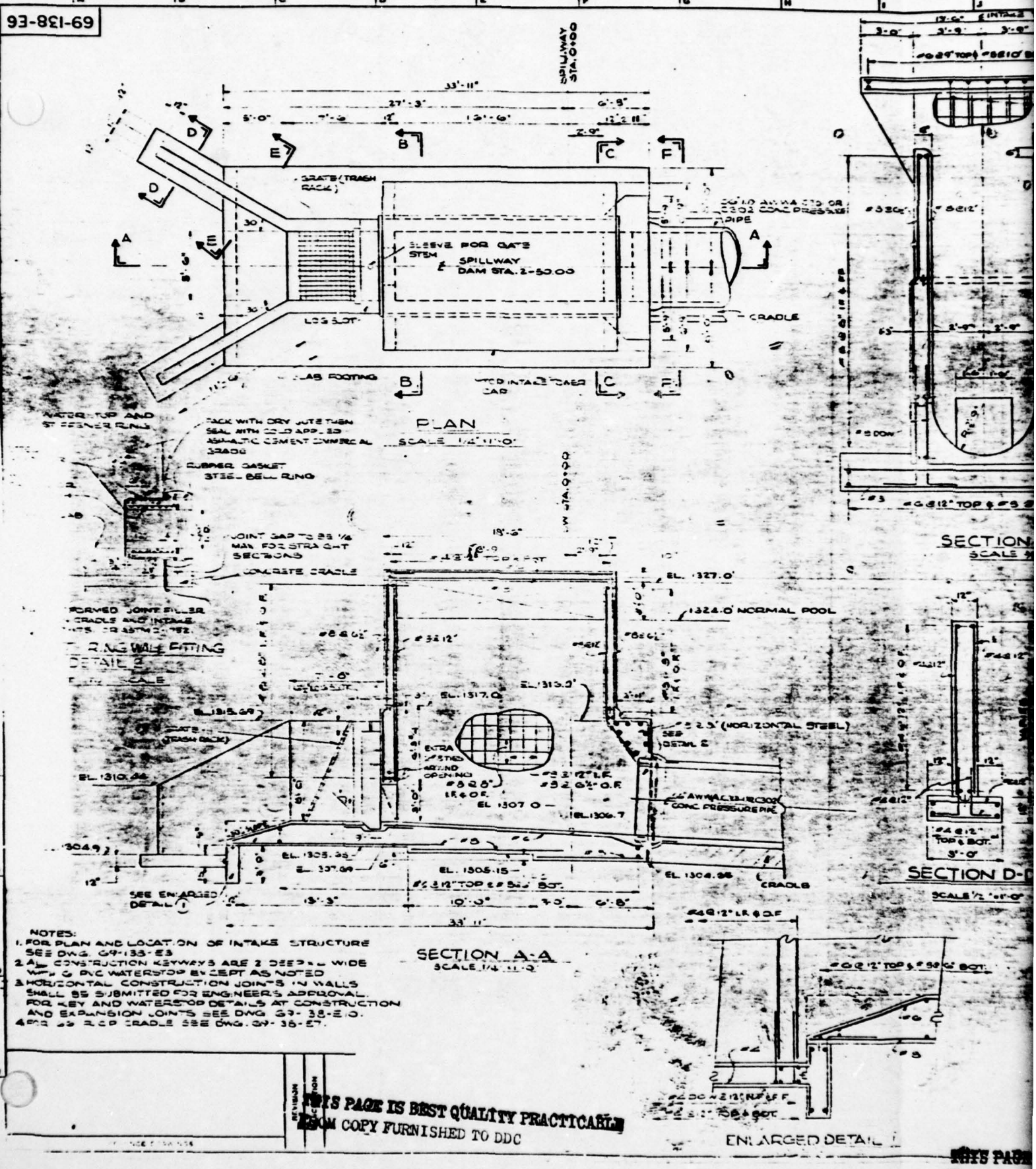
ROAMING WOODS LAKE DAM

NAT. ID NO. PA.00166 WAYNE COUNTY

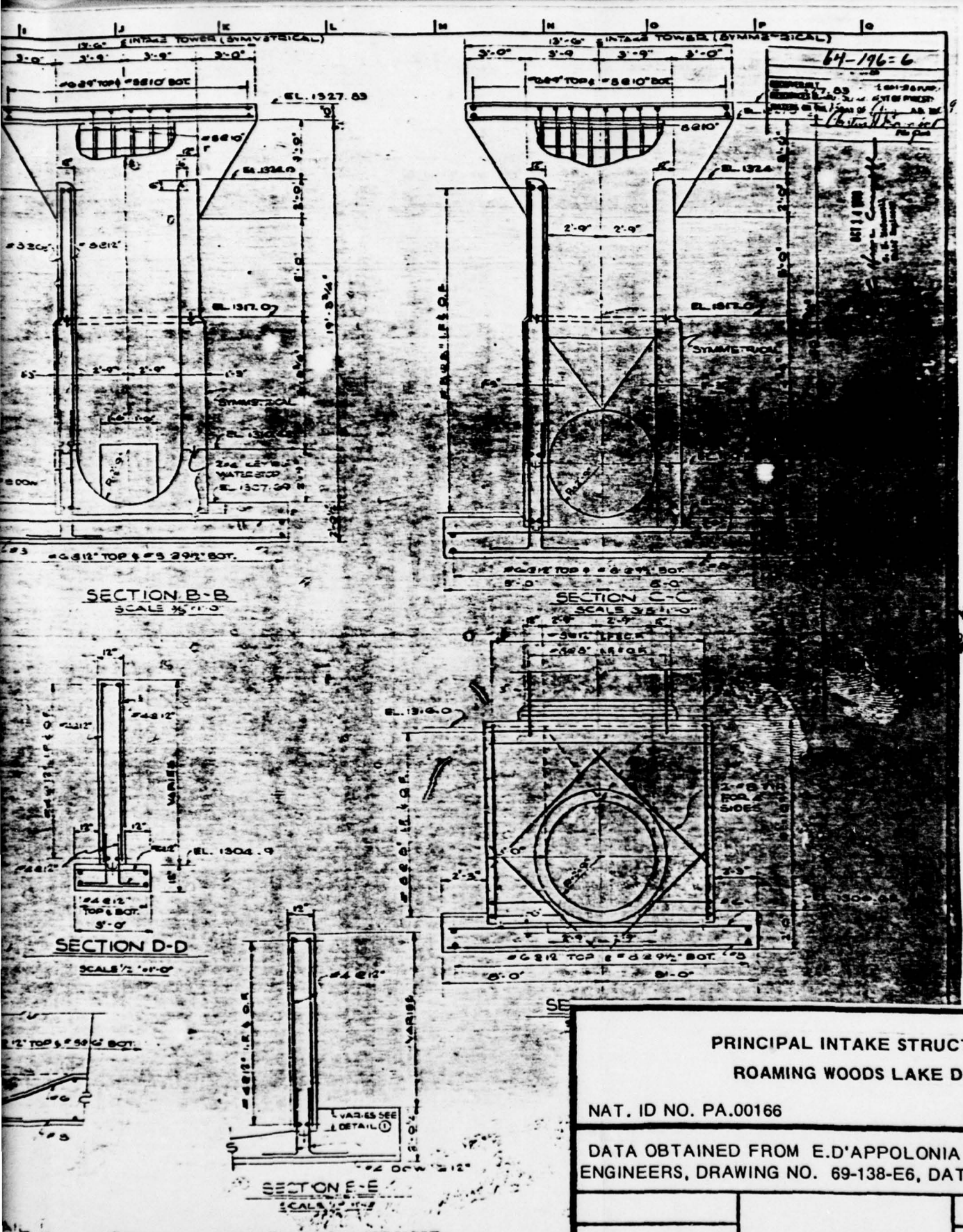
DATA OBTAINED FROM E.D'APPOLONIA CONSULTING ENGINEERS, DRAWING NO. 69-138-E4, DATED AUGUST, 1967

PLATE 3

69-138-E6



NOTES:
1. FOR PLAN AND LOCATION OF INTAKE STRUCTURE SEE DWG. 69-138-E3
2. ALL CONSTRUCTION KEYWAYS ARE 2" DEEP x 6" WIDE WITH 6" PVC WATERSTOP EXCEPT AS NOTED
3. HORIZONTAL CONSTRUCTION JOINTS IN WALLS SHALL BE SUBMITTED FOR ENGINEER'S APPROVAL. FOR KEY AND WATERSTOP DETAILS AT CONSTRUCTION AND EXPANSION JOINTS SEE DWG 69-138-E10.
4. FOR 24" R.C.P. CRADLE SEE DWG. 69-138-E7.



64-196-6

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PRINCIPAL INTAKE STRUCTURE

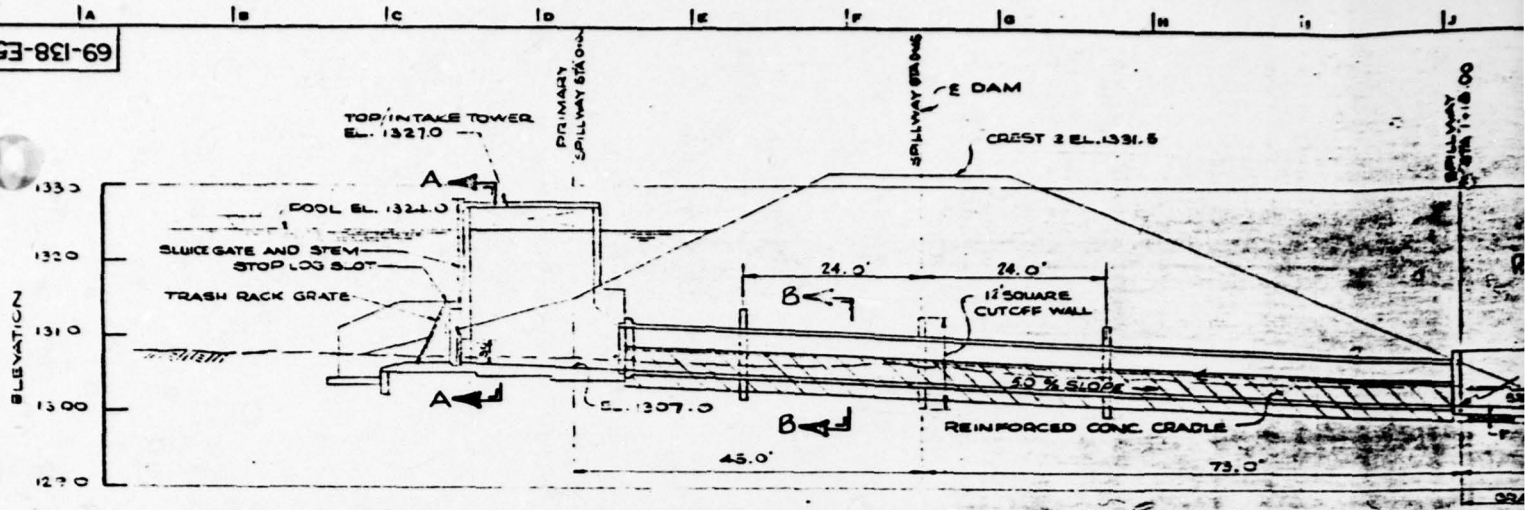
ROAMING WOODS LAKE DAM

NAT. ID NO. PA.00166 WAYNE COUNTY

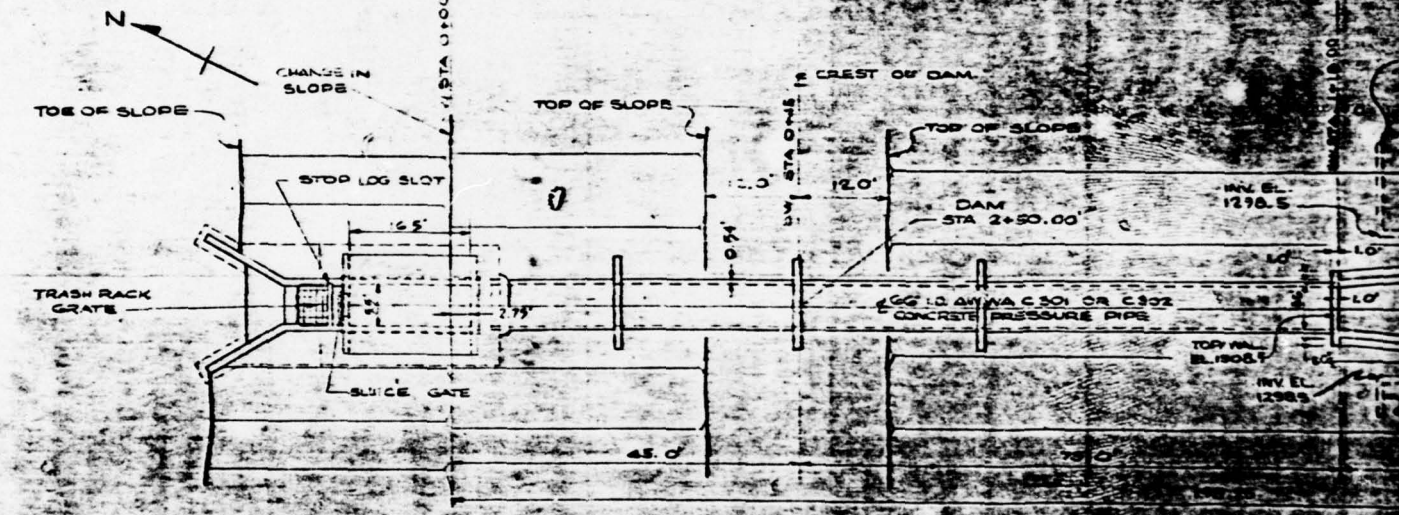
DATA OBTAINED FROM E.D'APPOLONIA CONSULTING ENGINEERS, DRAWING NO. 69-138-E6, DATED AUGUST, 1967

PLATE 4

69-138-E5

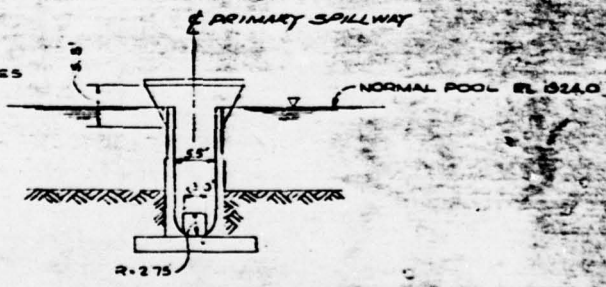


PROFILE AT CENTERLINE OF SPILLWAY
SCALE 1"=10.0'

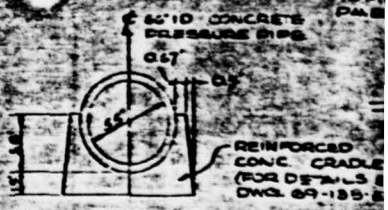


SPILLWAY PLAN
SCALE 1"=10.0'

SMALL ANIMAL GUARD DETAILS
FOR 8" CMP
NOT TO SCALE

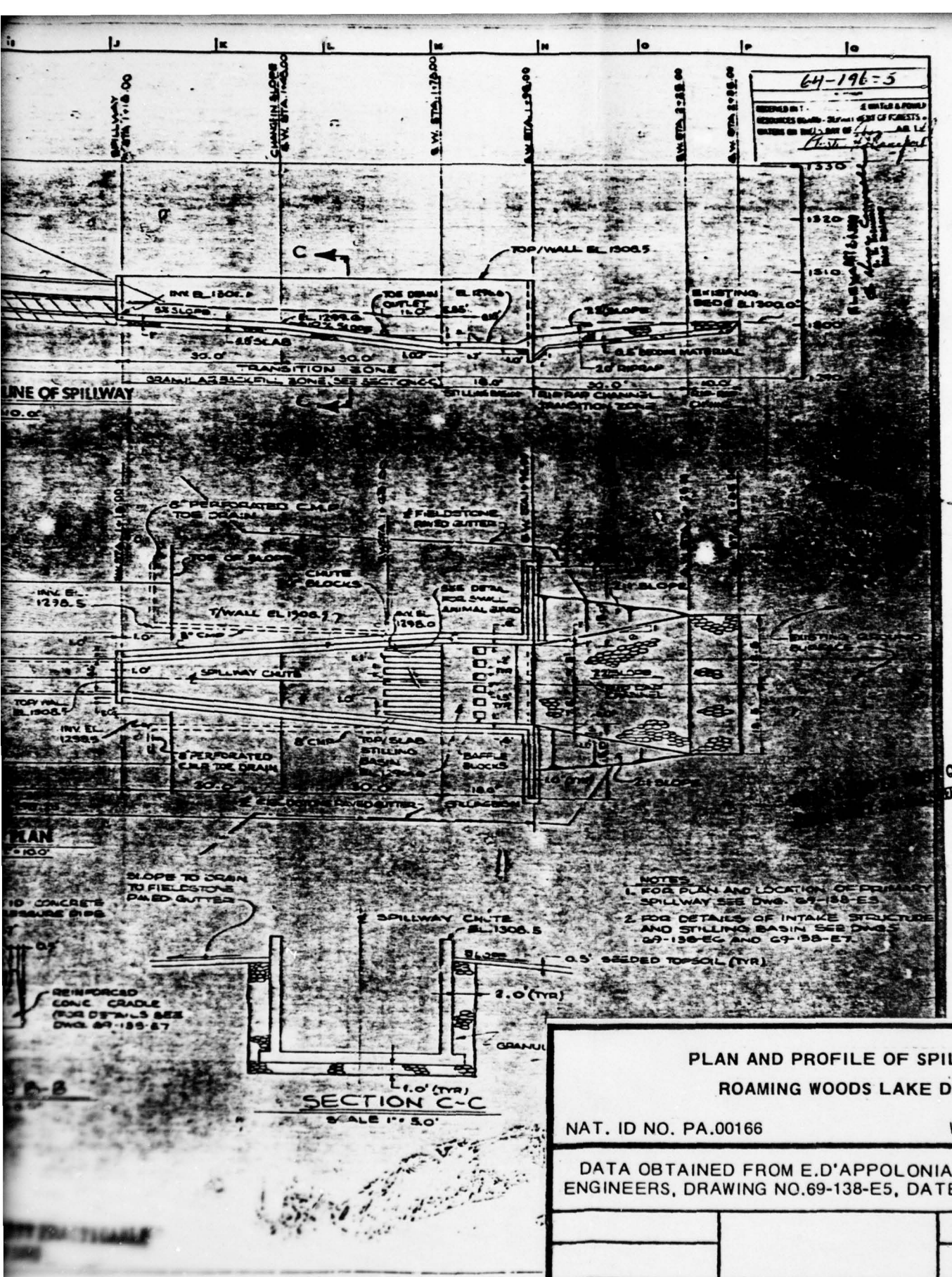


SECTION A-A
SCALE 1"=10.0'



SECTION B-B
SCALE 1"=5.0'

REVISION	DESCRIPTION



PLAN AND PROFILE OF SPILLWAY

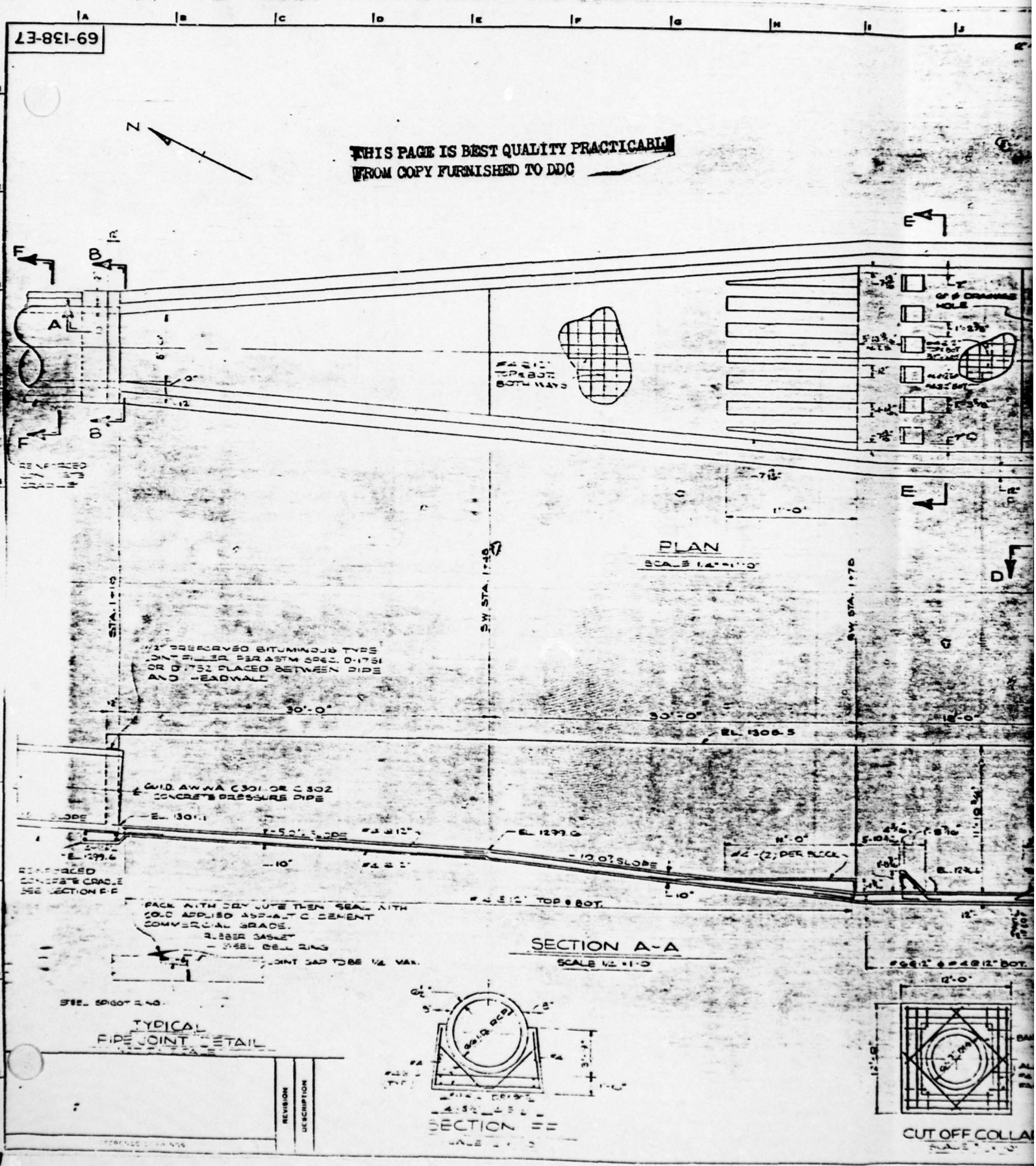
ROAMING WOODS LAKE DAM

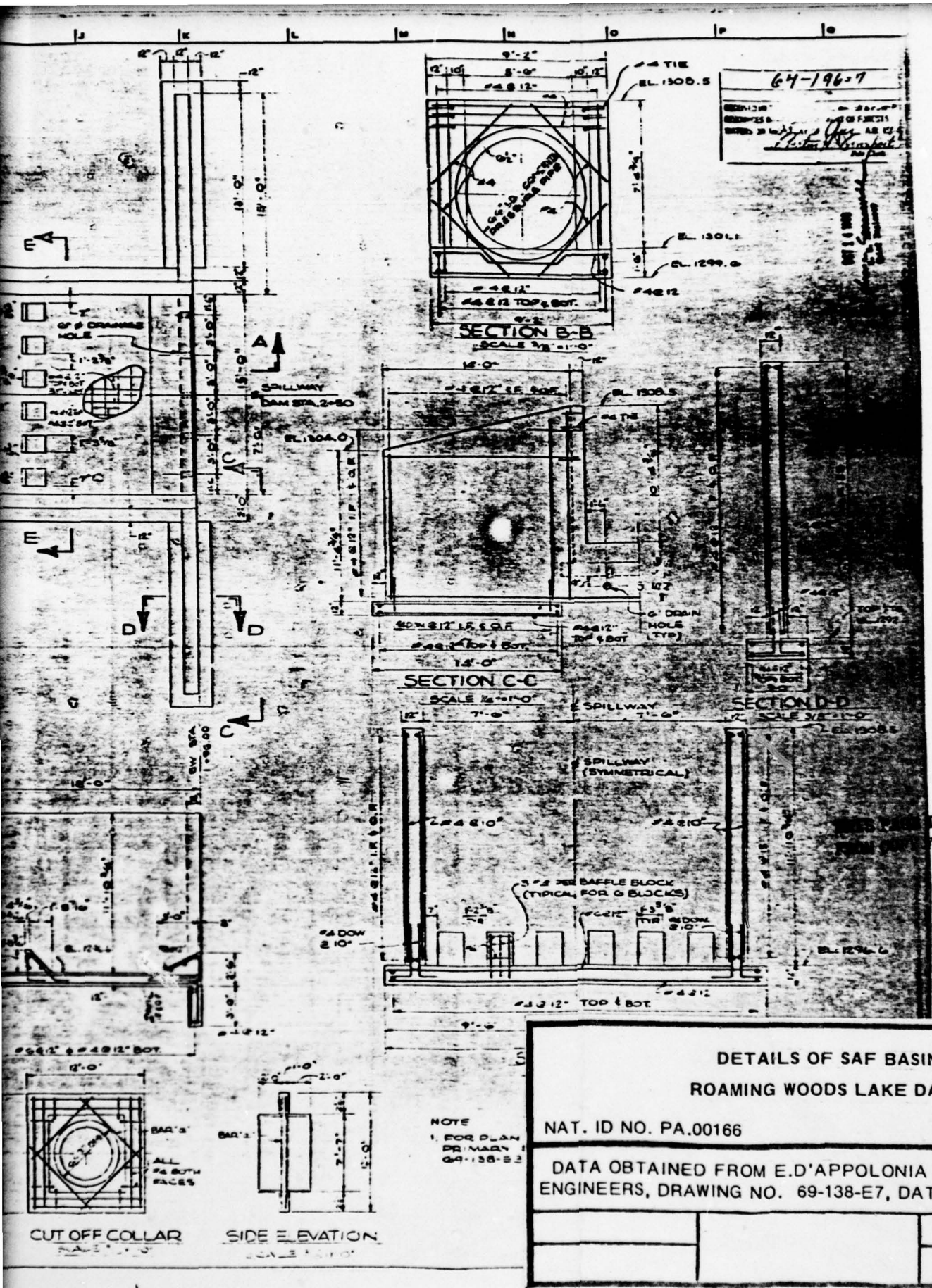
NAT. ID NO. PA.00166 WAYNE COUNTY

DATA OBTAINED FROM E.D'APPOLONIA CONSULTING ENGINEERS, DRAWING NO.69-138-E5, DATED AUGUST, 1967

PLATE 5

69-138-E7





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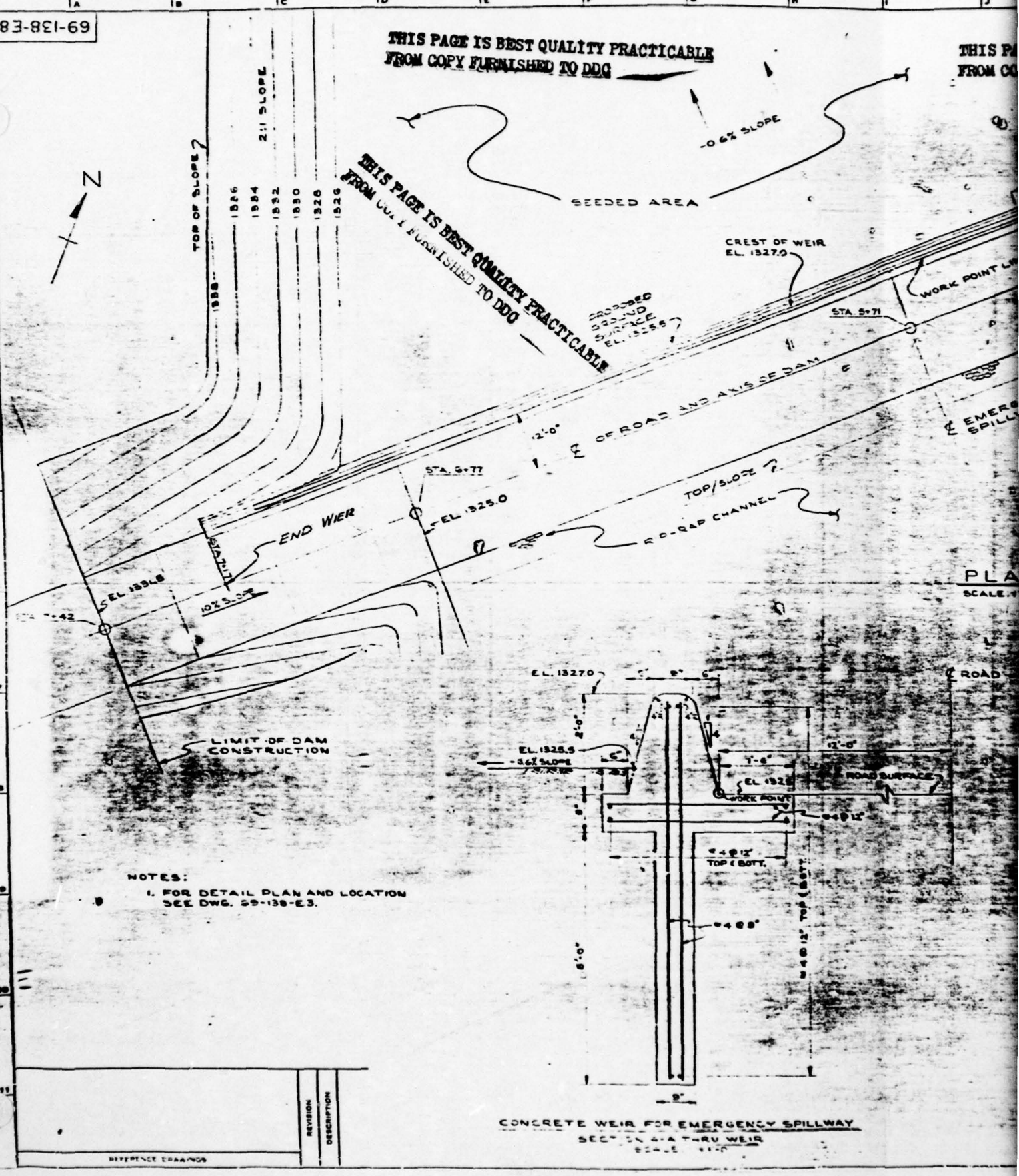
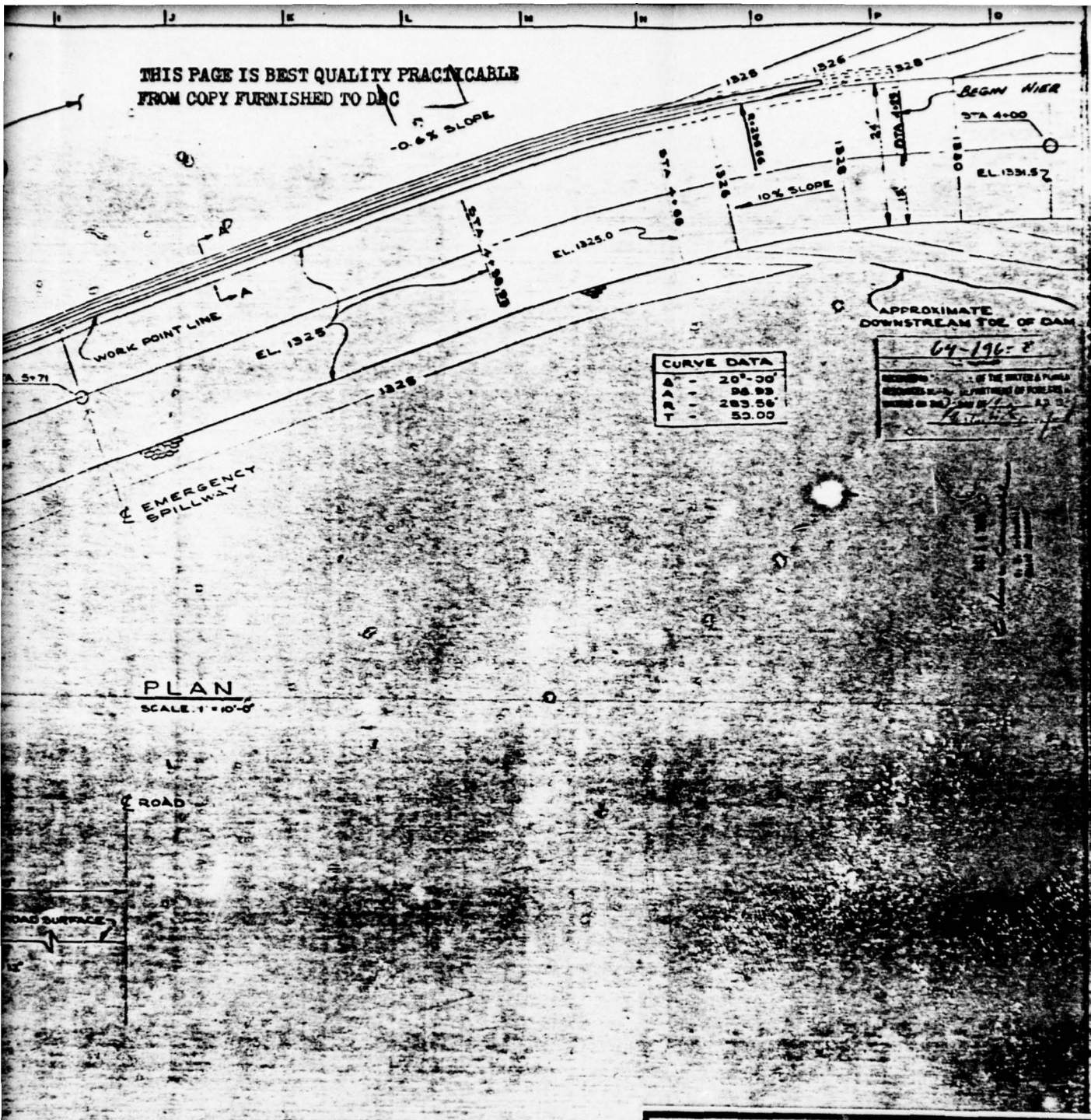
DETAILS OF SAF BASIN ROAMING WOODS LAKE DAM		
NAT. ID NO. PA.00166		WAYNE COUNTY
DATA OBTAINED FROM E.D'APPOLONIA CONSULTING ENGINEERS, DRAWING NO. 69-138-E7, DATED AUGUST, 1967		
		PLATE 6

69-138-E8





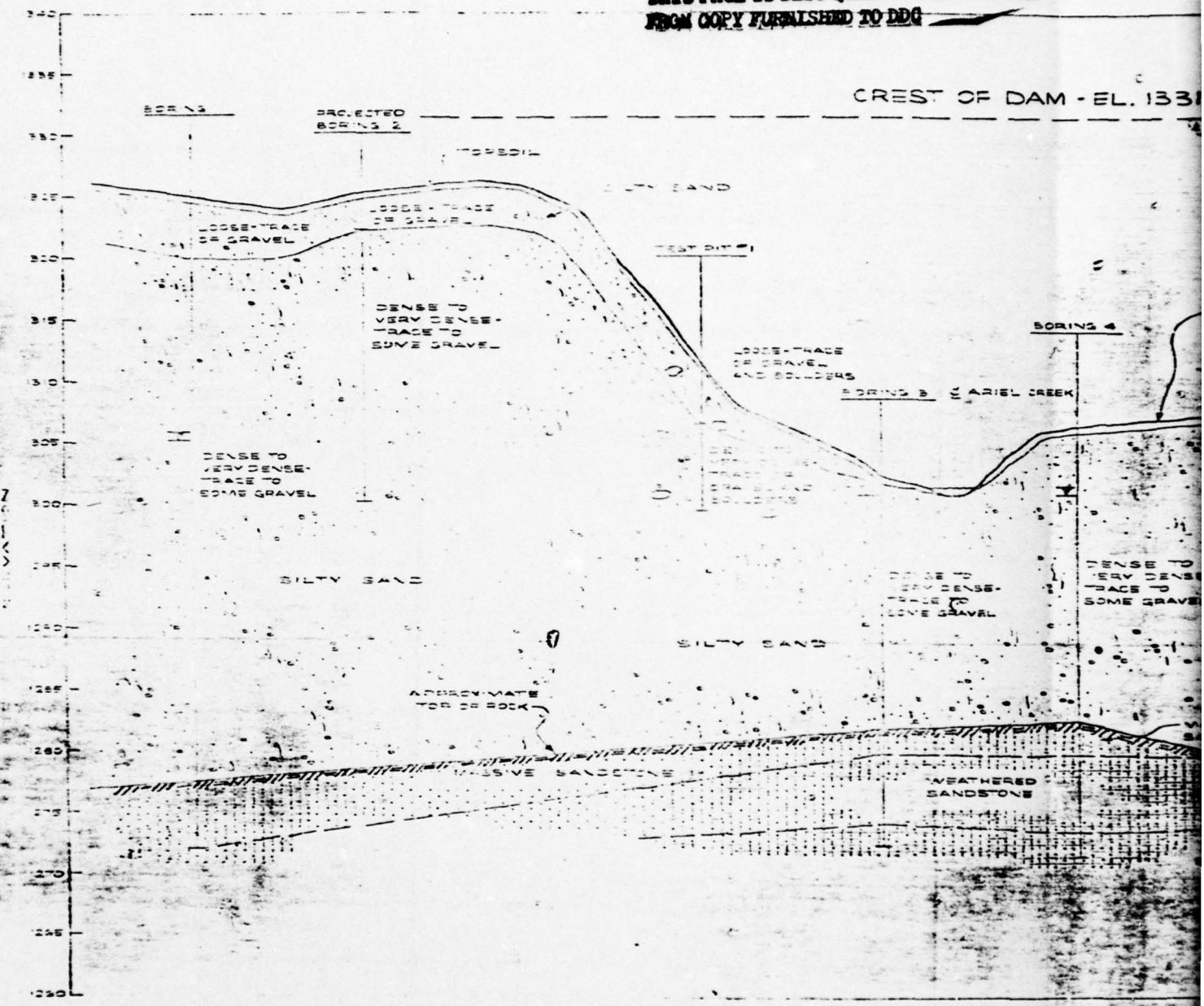
NOTE
1. FOR DETAILS
SPILLWAYS, S

PLAN AND PROFILE OF EMERGENCY SPILLWAY
ROAMING WOODS LAKE DAM

NAT.ID NO. PA.00166 WAYNE COUNTY

DATA OBTAINED FROM E.D'APPOLONIA CONSULTING ENGINEERS, DRAWING NO.69-138-E8, DATED AUGUST,1967

PLATE 7

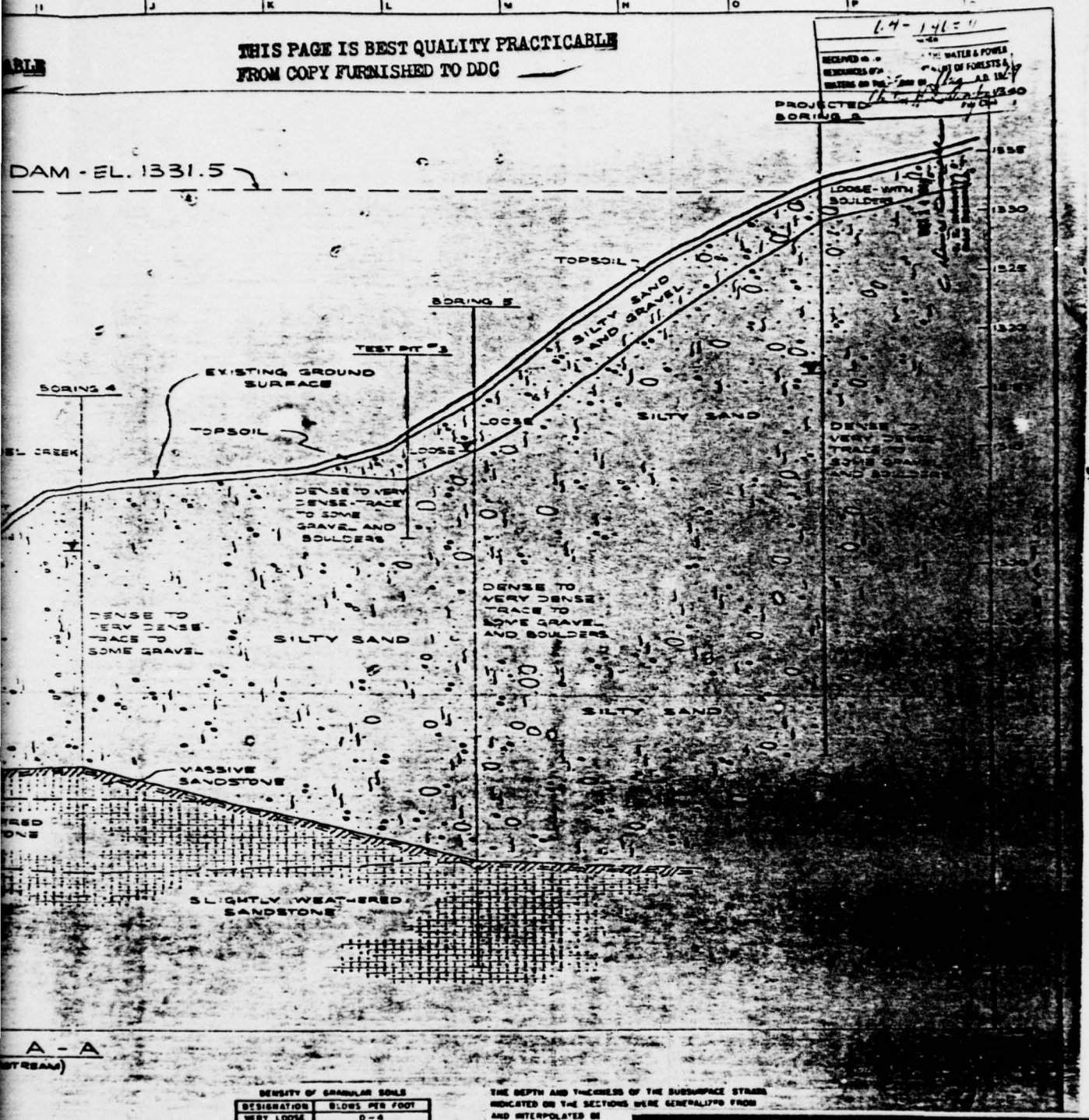


SECTION A - A
(LOOKING UPSTREAM)

NOTE
SUBSURFACE INFORMATION SHOWN ON THIS DRAWING WAS OBTAINED SOLELY FOR USE IN ESTABLISHING DESIGN CONTROLS FOR THE PROJECT. THE ACCURACY OF THIS INFORMATION IS NOT GUARANTEED AND IT IS NOT TO BE CONSTRUED AS PART OF THE PLANS GOVERNING CONSTRUCTION OF THE PROJECT.

NOTES:
1. FOR PLAN AND LOCATION OF BORINGS AND TEST PITS, SEE DWG. 69-138-E2.
2. FOR DETAILED DESCRIPTION OF BORINGS AND TEST PITS, GENERAL NOTES AND LEGEND, SEE DWG. 69-138-E10 AND E11.
3. BORINGS NOT LOCATED ON THE SECTION LINE WERE PROJECTED PERPENDICULAR TO THE SECTION LINE.

REVISION
DESCRIPTION
REFERENCE DRAWINGS



A - A

DENSITY OF GRANULAR SOILS

DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 - 4
LOOSE	5 - 10
MEDIUM DENSE	11 - 30
DENSE	31 - 50
VERY DENSE	OVER 50

THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BE... MATION OR ACTUAL S... ONLY AT THE LOCATI... IS POSSIBLE THAT SA... THE TEST BORINGS W...

HORIZ...
20
VERT...

GEOLOGIC SECTION ALONG CENTERLINE

ROAMING WOODS LAKE DAM

NAT.ID NO.PA.00166 WAYNE COUNTY

DATA OBTAINED FROM E.D'APPOLONIA CONSULTING ENGINEERS. DRAWING NO.69-138-E11, DATED AUGUST,1967

PLATE 8

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APPENDIX

F

SITE GEOLOGY
ROAMING WOODS LAKE DAM

Roaming Woods Lake is located in the Low Plateaus section of the Applachian Plateau Physiographic Province. The underlying bedrock is composed of red and gray sandstones, siltstones and shales belonging to the Catskill Formation of Upper Devonian age. See Plate F-1. Bedding is generally horizontal with some minor localized folding (White, 1881; Lohman, 1937). No faulting has been documented in the site area, but joints and fractures in the Catskill Formation are usually well developed, particularly in the shales and siltstones, where they tend to be closely spaced and uniform. These joints are usually open and near-vertical, having rather variable strikes (White, 1881; Lohman, 1933; Sevon, 1975).

The region was glaciated during the Wisconsin glaciation of Pleistocene age, resulting in the deposits of glacial drift found along streams, filling valleys, and covering much of the highlands in the site area (Leverett, 1957).

Downstream seepage should not be a major problem unless the jointing orientations at the dam site are locally consistent, closely spaced, and oriented at some angle nonparallel to the dam structure.

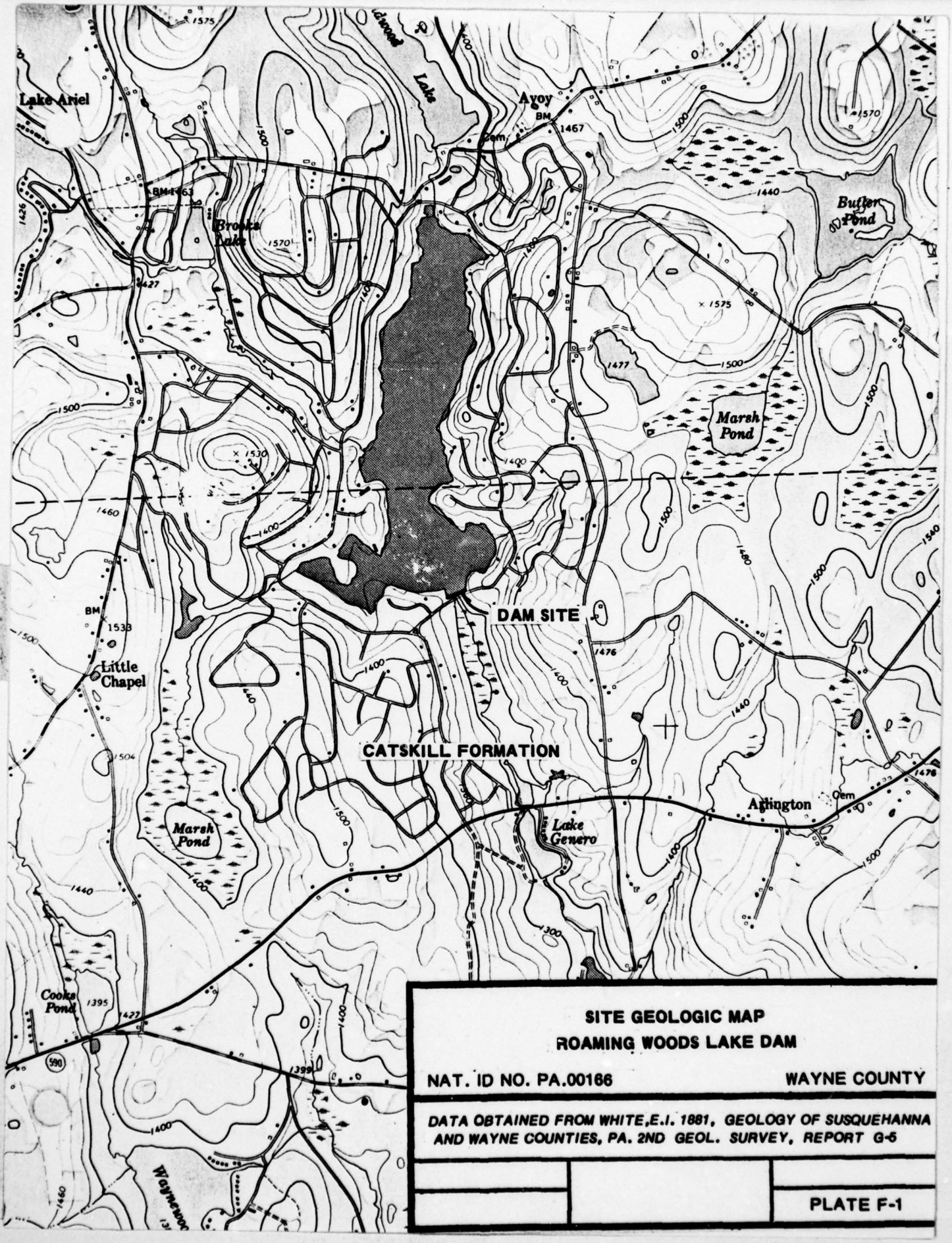
References:

1. *Lohman, S.W., 1957, Ground Water in Northeastern Pennsylvania: Pa. Geol. Survey, 4th Series, Bull. W-4, 312 p.*

2. *Leverett, Frank, 1957, Glacial Deposits Outside the Wisconsin Terminal Moraine in Pennsylvania: Pa. Geol. Survey, 4th Series, Bull. G-7, 123 p.*

3. *Sevon, W.D., 1975, Geology and Mineral Resources of the Christmans and Pohopoco Mountain Quadrangles, Carbon and Monroe Counties, Pennsylvania: Pa. Geol. Survey Atlas 195 ab, Plate 1, 1:24,000.*

4. *White, I.C., 1881, Geology of Susquesharna and Wayne Counties, Pennsylvania: Pa. 2nd Geol. Survey, Report G-5, 24 p.*



SITE GEOLOGIC MAP

ROAMING WOODS LAKE DAM

NAT. ID NO. PA.00166 **WAYNE COUNTY**

DATA OBTAINED FROM WHITE,E.I. 1881, GEOLOGY OF SUSQUEHANNA AND WAYNE COUNTIES, PA. 2ND GEOL. SURVEY, REPORT G-5

PLATE F-1